M101-P/M102-P Parameter Description

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Notes:
This file is for M102-P V2.0 only.

1 Introduction

1.1 Objective

The objective of this document is to provide parameter description of M101-P/M102-P. Each chapter consists of brief explanation of the function, the involved parameters, and the parameter description along with the range. The default values of all the parameters are listed in appendix “Factory settings for M101-P/M102-P”.

Some examples and further explanations are provided for user’s reference in parameterisation.

1.2 Related documentation

1TNC911115D0202 M101-P/M102-P User’s Guide

1TNC911104M0202 Mcusetup User’s manual

1TNC911507M0202 PROFIBUS Protocol Implementation for M101-P/M102-P

2 Document Overview

The parameterisation of M101-P/M102-P can be done either from service laptop or workstation with Mcusetup-P software installed. The motor related parameters and the protection function are to be set based on the motor manufacturer’s data sheet.

The parameterisation in the M101-P/M102-P is mainly classified into following functions:

COMMS (Communication)

Motor Information

Control Authority

Motor Grouping

Digital Inputs

Programmable Outputs

TOL Protection

Stall Protection

Phase Failure Protection

Unbalance Protection

Underload Protection

Noload Protection

Earth fault Protection

PTC Protection

Undervoltage Protection & Autorestart (only for M102-P)

Start Limitation Protection

Maintenance

Diagnosis Information

User Defined Data

These functions are further subdivided into parameters, which need to be set individually. The above functions and its related parameters are covered in each of the subsequent chapters.

While changing any parameter, the related parameters that are affected should be noticed by the user and shall be changed if necessary.

3 Motor Information

Motor information consists of parameters, which reflects the configuration of motor feeder. For example the ratings for external current transformers and contactor feedback supervision are included.
Parameters involved with the Motor Information are as below:

Notes:

Starter Type

Motor Type

System Supply Voltage

System Frequency

Motor Power Rating

Startup Time (N1)

Startup Time (N2)

Changeover time (only for M102-P)

Ramp Up Time (only for M102-P)

Ramp Down Time (only for M102-P)

Failsafe Mode

Communication Failure delay

Feedback

Internal CT Primary

Earth Fault Primary

Motor Nominal Current

Motor Nominal Current (N2)

VT Primary(L-N) (only for M102-P)

External CT Used

External CT1 Primary

External CT2 Primary

3.1 Starter Type

Function : Motor information

Range : M101-P:NR-DOL, NR-DOL/RCU, REV-DOL, REV-DOL/RCU, Feeder

M102-P: NR-DOL, NR-DOL/RCU, REV-DOL, REV-DOL/RCU,Actuator, NR-S/D, NR-2N, Autotransformer, NR_Softstarter, REV_Softstarter, Feeder

Default setting : NR-DOL

Related parameters :

Motor information / N2 parameters (NR-2N)

Motor information / S/D parameters (NR-S/D)

Motor information / Autotransformer parameters

Motor information / Ramp Up/Down Time

Description :

M101-P/M102-P supports different kinds of motor connections. This parameter need to be set according to type of control desired for the motor.

More detail of M101-P/M102-P starter types is described in M101-P/M102-P User Guide.

NR-DOL: Non Reversing Direct On Line.

NR - Non Reversing means that the motor only runs in one direction.

When a “Start” command is given, the internal relay CCA remains closed until a stop command is given. The internal relay CCB & CCC has no function here.

NR-DOL/RCU: Non Reversing Direct On Line (remote control of the contactor, bypassing the M101-P/M102-P).

The “Start CW” command closes the internal relay CCA 1sec respectively. The stop command will close

Notes:

relay CCC for 1 sec. The wiring of the self-auxiliary contact across the start command latches the contactor.

Removing the M101-P/M102-P from the starter will not prevent RCU operation depending however on the connection (external relay and/or switch is used for start and stop). The stop pulse issued by the M101-P/M102-P will override the RCU-switch start position.

REV-DOL: Reversing Direct On Line.

REV- Reversing means that the motor can run in both directions (clockwise CW, counter clockwise CCW).

REV-DOL is reversing direct on line starters. The motor can be run both directions (clockwise and counter clockwise) and can be stopped.

When “Start CW” command is given, the internal relay CCA remains closed until the stop command is given. The direction of the motor can be changed only after a stop. Similarly, when CCW start command is given, the internal relay CCB remains closed until a stop command. The relay CCC has no function.

REV-DOL/RCU: Reversing Direct On Line (remote control of the contactor, bypassing the M101-P/M102-P).

The “Start CW” command closes the internal relay CCA 1sec respectively. The “Start CCW” command closes the internal relay CCB 1sec respectively only after a stop. The stop command will close relay CCC for 1 sec. The wiring of the self-auxiliary contact across the start command latches the contactor.

Removing the M101-P/M102-P from the starter will not prevent RCU operation depending however on the connection (external relay and/or switch is used for start and stop). The stop pulse issued by the M101-P/M102-P will override the RCU-switch start position.

ACTUATOR(only for M102-P): Reversing starters for applications like valves, dampers, actuators etc.

Actuator starters are reversing direct on line starters where the limit switch inputs are used to stop the motor from running further after reaching the respective end positions. When one of the limit switch inputs is active, the motor can be started in another direction only.

In case of an actuator starter with torque sensor, the torque switch associated with the sensor is used to stop the motor. The limit switch will inhibit the starting to the respective direction and indicate the respective stop position.

One of the digital inputs can be used as input for the torque sensor. If the torque sensor activates before the limit switch, the motor is tripped with a message ‘DI trip’.

NR-S/D (only for M102-P): Reduced voltage starting in star and running of the motor in delta after meeting the transition conditions.

Star-delta starters are used mainly to restrict the starting current of a motor due to supply limitations. The motor is started with the winding connected in star and transferred to delta after the "Changeover time". The starting at a lower voltage also reduces shocks on the motor coupling, belts and the gear mechanisms. The starting current and the torque is reduced to 1/3 of the DOL value. However, it must be determined whether the reduced motor torque is sufficient to accelerate the load over the whole speed range.

The changeover is based on “time”, the star to delta transition takes place after the parameterised "Changeover time".

The star to delta switchover is done with a transition time of maximum to ensure quenching of the arc in star operation before it changes over to delta to prevent short-circuit.

During the contactor transitions, the M102-P waits until the previous sequence is successfully completed. In case of any contactor failure the feedback supervision trip will open all the contactors.

NR-2N(only for M102-P): Non-reversible two speed motor.

Two speed drives are used for applications requiring dual motor outputs. In case of two speed drives there are separate commands for the two speeds. When started by command ‘speed1’ the contactor CCA is closed and when started by command ‘speed2’ the contactor CCB is closed. The contactor CCC is used for stopping the motor. Two speed starter can be implemented either as “Dahlander” or “separate winding” starter.

Current measurement for two speed starter uses external current transformer.

Autotransformer(only for M102-P): Non-reversible motor starter based on reduced voltage via auto-transformer.

Notes:

Auto-transformer is used in order to reduce motor start current during start condition. While reduced voltage limit the starting current also usable torque is limited significantly. This must be considered carefully when designing starter based auto-transformer.

NR_Softstarter(only for M102-P): Non-reversible Softstarter control

Softstarter applications are for controlling motor accessory softstarter device. M101-P/M102-P gives start and stop commands to the softstarter unit. The softstarter is set for adjusting motor voltage with it's own parameters. More information about softstarter can be found from softstarter's manual.

When "Start" command is given, the internal relay CCA remains closed until the stop command is given.

Rev_Softstarter (only for M102-P) : Reversible softstarter control

Functionality of this starter type is according to NR-softstarter starter with support for reversing use of motor.

When "Start CW" command is given, the internal relay CCA is closed first to control contactor followed by the closing of CCC to start the softstarter. CCA & CCC remain closed until a stop command. The direction of the motor can be changed only after a stop. Similarly, when CCW start command is given, the internal relay CCB is closed first to control contactor, then, the CCC is closed to start the softstarter. CCB & CCC remain closed until a stop command.

Feeder: The feeder application is regarded as specific starter type in M102. For feeder mode, the dedicated motor protections are either auto-inhabited or prohibited via parameter setting. The trip sign of circuit breaker is detected by M102 via specified inputs before an alarm can be given out. All the measurement and control's functions are activated for this application.

Note: The internal relays CCA and CCB are electrically interlocked for all starter type.

3.2 Motor type

Function : Motor information

Range : 1=Single Phase, 3=Three Phases

Default setting : 3=Three Phases

Related parameter : Motor Information / Starter Type
Phase Failure Protection / Function
Unbalance Protection / Function

Description :

M101-P/M102-P can handle a single or three phase AC motor. Based on the number of phases of the motor, single or three can be selected. For single-phase motors, the motor current lead or the CT secondary lead (for > 63 A) is passed through L1 phase window of the M101-P/M102-P internal current transformer.

Attention! Single Phase application is practicable with NR-DOL starter type. Neither the phase failure protection nor the unbalance protection is available for the application.

3.3 System Supply Voltage (only for M102-P)

Function : Motor Information

Range : 220(1)690V

Default setting : 380V

Related parameter : Motor information / VT Primary(L-N)

Description :

The parameter defines the rated voltage of main supply for motor.

3.4 System Frequency

Function : Motor information

Range : 45(1)65Hz

Default setting : 50Hz

Related parameter : --

Notes:

Description :

The user can assign a value within to describe the value of system supply frequency. This message is for reference only and does not affect operation of the M101-P/M102-P.

3.5 Motor Power Rating

Function : Motor information

Range : 0.01(0.01)1000kW

Default setting : 1.5kW

Related parameter : Motor Information / Motor Nominal Current (N1)

Motor Information / Motor Nominal Current (N2)

Description :

This is the reference data at rated voltage and frequency. The value is given on the motor rating plate and does not affect operation of the M101-P/M102-P.

3.6 Startup Time (N1)

Function : Motor information

Range : 1 (1) 250 s

Default setting : 5s

Related parameter : Motor information / Starter type (all)

Motor information / Changeover time

TOL protection / TOL alarm

Stall protection / Function enable, disable

Phase failure protection / Function enable, disable

Unbalance protection / Function enable, disable

Earth fault protection / Function enable, disable

Underload protection / Function enable, disable

Noload protection / Function enable, disable

Description :

Motor startup time parameter is used to define the maximum startup time for the motor. It is the time that is required for the motor to complete its starting sequence. The starting sequence is said to be complete, when the startup current reaches 1.25 times the nominal current.

This parameter defines the length of time for the startup phase of the motor during which the “Overload alarm” message and stall protection functions are deliberately suppressed. In the case of M101-P/M102-P, in addition to the above, the underload, the unbalance, and the earth fault protection functions are suppressed.

3.7 Startup Time (N2)

Function : Motor information

Range : 1 (1) 250 s

Default setting : 5s

Related parameter : Motor information / Motor startup time (N1)

Motor information / Starter type (NR-2N, REV-2N)

Description :

This parameter is defined as the same as the definition of the previous parameter ‘Motor Startup Time’, except that it is dedicated for speed N2.

3.8 Changeover Time (only for M102-P)

Function : Motor information

Notes:

Range : 1 (1) 250 s

Default setting : 5s

Related parameter : Motor information / Starter type (NR-SD, Autotransformer)
Underload protection / Enabled, disabled
No load protection / Enabled, disabled

Description :

This parameter is applied to both NR-SD starter and Autotransformer starter. In the case of autotransformer starter, the parameter defines the time that motor is running with reduced voltage, that is, the motor changes to line voltage connection when the defined time elapsed. For SD starter, the start to delta transition is executed after the defined time.

3.9 Ramp Up Time (only for M102-P)

Function : Motor information

Range : 1 (1) 250 sec

Default setting : 10s

Related parameter : Motor information / Starter type (NR-Softstarter, REV-Softstarter)
Phase Failure Protection
Unbalance Protection
Underload Protection
Noload Protection

Description :

Softstarter is a separate unit to start motor in a smooth way by limiting inrush current. The ramp up time is the parameter of softstarter set to start up the motor. Upon this delay the listed protection functions are deactivated:

-Phase current loss

-Unbalance

-Underload

-No load

M102-P control the motor by giving start/stop commands to the softstarter. The motor protection is done by the softstarter during startup.

Note: The accuracy of the current measurement is affected by the harmonics caused by the soft starters.

3.10 Ramp Down Time (only for M102-P)

Function : Motor information

Range : 1 (1) 250 sec

Default setting : 10s

Related parameter : Motor information / Starter type (NR-DOL, REV-DOL)
Phase Failure Protection
Unbalance Protection
Underload Protection
Noload Protection

Description :

Softstarter unit has a parameter which is used to select the stop ramp time of the motor. M102-P is adapted to this stop time by setting the Ramp down time ≥ selected stop ramp time of the motor.

3.11 Failsafe Mode

Function : Motor control

Notes:

Range : NOP / Start1(CW) / Start2(CCW) / Trip

Default setting : NOP

Related parameter : Motor information / Starter type
Communication / Communication failure delay

Description :

M101-P/M102-P offers a failsafe function where the user has the possibility to decide motor status after a failure either in M101-P/M102-P internal communication or PCS communication to M101-P/M102-P. If the M101-P/M102-P detects a failure in communication, a stored command is executed after a pre-parameterized Communication failure delay.

3.12 Communication Failure Delay

Function : PROFIBUS communication

Range : 1(1)25s or 255s

Default setting : 255s

Related parameter : -

Description :

This parameter is to set the allowed time period in which no activity occurs on the communications ports. After the delay, M101-P/M102-P will turn into Failsafe mode automatically.
If the serial communications link is used to control a process with several motors working together, it may be desirable to shut down the motor if communication control is lost. When no activity occurs on the communication port for 1 to 25 seconds, it will trip if this feature is enabled. If the value is set to be 255s the function of communication failure will no response even existing communication failure.

3.13 Feedback

Function : Motor information

Range : enabled /disabled

Default setting : enabled

Related parameter : Motor control / Starter type

Description :

The contactor feedback supervision functions provided by M101-P/M102-P can be implemented via I/O terminals. Moreover, in NR-DOL and NR-DOL/RCU the contactor feedback via predefined input can be disabled by setting the parameter here and the feedback supervision functionality in M101/M102 is based on the current detected by the device.

3.14 Internal CT Primary

Function : Motor information

Range : 0.5~1.0(5T),0.5~1.0(2T),0.5~1.0(2T),
1.0~2.5,2.5~5.0,5.0~12.5,12.5~30.0,30.0~63.0

Default setting : 2.5~5.0A

Related parameters : Motor information / Nominal Current(N1)
Motor control / Nominal Current (N2)
Motor information / External CT Installed
Motor information / External CT1 Primary
Motor information / External CT2 Primary

Description :

M101-P/M102-P with internal CT can handle the motor with rated current up to 63A. The parameter is used to describe the primary of internal CT. To ensure the accuracy of measurement, pls follow the rule that motor rating shall be a value among 0.4-1 CT primary. For example, as a 1.5kW, 3.5A motor, this parameter is recommended to be set as 2.5~5.0A.

While using an external current transformer for motor nominal current >63 A, the setting of the

Notes:

parameter must in line with the external CT secondary, 5A and 1A are available in this case.
If motor's nominal current is lower 0.08A it should increase the current circle (T) to measure the current. For example, as a 0.1A motor, this parameter is recommended to be set as 0.5~1.0(5T) and end-user must increase current circle to 5T.

3.15 Earth fault primary

Function : Motor information

Range : 1A or 5A

Default setting : 1A

Related parameters : Earth Fault Protection / Function
Earth fault protection / Alarm level
Earth fault protection / Trip level

Description :

The parameter defines the maximum primary current of the RCT.

3.16 VT Primary (L-N) (only for M102-P)

Function : Motor information

Range : 110(1)250V

Default setting : 220V

Related parameters : Motor information / System supply voltage
Undervoltage Protection and Autorestart

Description :

This is used to define the input of internal voltage transformer serving for voltage related protection. The value of VT Primary is computed automatically according to the value of power supply voltage.

3.17 Motor Nominal Current (N1)

Function : Motor information

Range : 0.4-1.0 I_{prim}

Default setting : 4A

Related parameters : Motor Information / Motor Power Rating
Motor information / External CT parameters

Description :

This is the rated current In of the motor, at rated load, at rated voltage and frequency. The value is given on the motor rating plate. The rated current can be set within this range.

In the case of starter with external current transformers, the range is dependent on the nominal primary current of the current transformer. The range varies from 0.4 to 1.0 of CT nominal primary current.

Example: In the case of an external current transformer of 100A, the range varies from 40 to 100A. The nominal motor current can be set within this range.

3.18 Motor Nominal Current (N2)

Function : Motor information

Range : 0.4-1.0 I_{prim}

Default setting : 0A

Related parameters : Motor Information / Motor Power Rating
Motor information / External CT parameters

Description :

This is the rated current In of the motor, at rated load, at rated voltage and frequency. The value is given on the motor rating plate. The rated current can be set within this range.

Notes:

In the case of starter with external current transformers, the range is dependent on the nominal primary current of the current transformer. The range varies from 0.4 to 1.0 of CT nominal primary current.

3.19 External CT Used

Function : Motor information

Range : Disabled, Enabled

Default setting : Disabled

Related parameters : Motor information / Nominal Current
Motor information / Nominal Current(N2)
Motor information / External CT1 Primary
Motor information / External CT2 Primary

Description :

An internal CT is integrated inside M101-P/M102-P when motor current is not up to 63A. However, External CTs are required when over than 63A. This parameter is to active external CTs input in the latter case.

Example: In the case of an external current transformer of 100A, the range varies from 40 to 100 A. The nominal motor current can be set within this range.

3.20 External CT1 Primary

Function : Motor information

Range : 1(1) 2000 A

Default setting : 100A

Related parameters : Motor information / Nominal Current
Motro control / Nominal Current(N2)
Motor information / External CT Installed
Motor information / Internal CT Primary
Motor information / External CT2 Primary

Description :

This parameter can only be set when ‘External CT Installed’ is enabled.

While using an external current transformer for motor nominal current >63 A, the nominal primary current of the external current transformer is defined by this parameter.

3.21 External CT2 Primary

Function : Motor information

Range : 1(1)2000 A

Default setting : 100A

Related parameters : Motor information / Starter type/NR-2N
Motor information / Nominal Current
Motro control / Nominal Current(N2)
Motor information / External CT Installed
Motor information / Internal CT Primary
Motor information / External CT1 Primary

Description :

This parameter can only be set when ‘External CT Installed’ is enabled. While two speed Motor information is used, another external CT2 must be used, the nominal primary current of the external current transformer is defined by this parameter.

An example of current related setting in M101-P/M102-P: NR-DOL Motor rating 45kW, 86A, External CT

Notes:

100/5.

Motor Information / Nominal Current	86A
Motor Information / Nominal Current(N2)	Not active
Motor information / External CT Installed	Enabled
Motor information / Internal CT Primary	2.5~5A
Motor information / External CT1 Primary	100A
Motor information / External CT2 Primary	Not active

4 COMMS (PROFIBUS DP Communication)

The communication function provided by M101-P/M102-P is basing on PROFIBUS-DP. The fieldbus interface is RS485. Parametering, remote control, data acquisition and transmission etc are implemented via the communication function.

More information of M101-P/M102-P communication, please refer to M101-P/M102-P User Guide and Profibus Protocol Implementation for M101-P/M102-P.

The parameters involved with the protection function are,

Device Address

Operating Mode

Block DP

4.1 Device Address

Function	: COMMS
Range	: 0-126
Default setting	: 1
Related parameter	: -
Description	:

Each M101-P/M102-P on the same serial communication network must have a unique address in the range of 0 to 126. Computer software driving the serial network must be configured to recognize each separate address.

4.2 Operating Mode

Function	: COMMS
Range	: DPV0
Default setting	: DPV0
Related parameter	: -

Description :
M101/M102 supports only profibus DPV0 operating mode so far.

4.3 Block DP

Function	: COMMS
Range	: Enabled/Disabled
Related parameter	: -
Description	:

The block DP function determines whether M101/M102 will update the parameters when receiving the initialization command from upward system. If it is ‘disabled’, the parameters in M101/M102 will be overwritten by the data transmitted from master station during startup of the DP master. If ’enabled’, the updating command from master DP during startup is ignored and the parameters are allowed to be set via parameter software only.

5 Control Authority

Notes:

There are different control modes from where the motor can be started, stopped. M101-P/M102-P provides 4 modes for motor control: MD (Operator panel), HMI(reserved), Local (via terminal) and Fieldbus (via bus communication).

With the Control Authority functionality it can be decided which one of the modes is applied to access the motor. M101-P/M102-P will accept the command via the authorized mode while refusing to pass on command from unauthorized mode to the motor.

In addition to authorize the control mode via the parameter, M101-P/M102-P has the functionality of authorizing control access via hardwire input when a digital input is defined to Loc/R. The default control mode as follows.

Loc/R input	Control Authority			
	Local	Fieldbus	Operator panel MD	HMI
0 (open input)	Disabled	Enabled	Enabled	Disabled(reserved)
1 (close input)	Enabled	Disabled	Enabled	Disabled(reserved)

When none of digital inputs is defined as Loc/R input, the function of Local/Remote is disabled, control commands only authorized by the control mode parameter. The default control mode as follows.

Local/Remote input	Control Authority			
	Local	DCS fieldbus	Operator panel MD	HMI
No Definition	Disabled	Disabled	Enabled	Disabled

Note: The blue-shaded fields can be set to either Enabled or Disabled via parameterisation, but for Profibus DPV0, it is only change the control authority via parameterisation kit.

5.1 Motor Control Mode

Function : Control Authority

Range : Enabled / Disabled

Default setting : MD (Operator panel)

Related parameter : Digital Inputs / Loc/R

Description :

When the “LOC/R” input is defined via parameterisation, the ‘Control Authority’ function here is automatically deactivated except MD and HMI. When cancelling the definition of “LOC/R” input, user can select the control mode as RCU, MD, Local, and Fieldbus.

RCU Start (Reserved): This mode showing the control access belonging to control box nearby the motor is automatically activated for selection when NR_DOL/RCU and REV_DOL/RCU modes are selected in motor starter type.

MD (Operator panel): M101/M102 accepts the command from operator panel to control the motor.

Local (via hardwire): This control mode is via hardwire from M101/M102 terminal inputs to start/stop motor. It is a common requirement always from DCS system.

Fieldbus (via bus communication): This item is to define the motor control mode as bus communication. Via communication port in M101/M102, up control system as PCS can easily control motor remotely.

HMI (Reserved): It is as an additional option for control via an operator control & monitoring station (Human Machine Interface).

6 Motor Grouping

Attention: The function of Motor Grouping is not available for Profibus-DPV0.

In the case of conventional switchgear, the operator can start or stop a process by sequentially starting or stopping of the motors. The required delay between the motors is introduced either manually or with the help of a timer and serial interlocks. This would increase the operators’ time, cabling and the initial cost of the starter.

With help of intelligent system, the operator could start or stop the process with a single group command. The start and stop delay can be set for individual motors. The serial communication with logical connections between devices reduces the cabling, process interlocks and the hardware. In case of abnormality in any motor of the group, a group tripping would follow.

In this context, a motor group means a collection of motors, which are operated by an individual group start or stop command. The successful start of the motor group is indicated.

Notes:

Note: Individual start/stop command from fieldbus can also be given to the devices located in the group as well as via the switches connected to the device I/O in the local mode.

The parameters under motor grouping function are as below:

Function Enable /Disable

Group Start Direction

Group Number

Group Identifier

Group Start Delay

Group Stop Delay

6.1 Function Enable, Disable

Function : Motor Grouping

Range : Enabled / Disabled

Default setting : Disabled

Related parameter : Motor grouping / Parameters

Description :

Motor grouping function can be disabled with the help of this parameter. When disabled, motor group function does not have any functionality in the M101-P/M102-P and all other parameters of the function (group number, group identifier, group start direction, group start / stop delay) are greyed out in the Mcusetup-P software.

6.2 Group Start Direction

Function : Motor Grouping

Range : CW / CCW

Default setting : CW

Related parameters : Motor grouping / Parameters
Motor information / Starter type

Description :

This parameter defines the direction of rotation of the motor when started by a group command. The rotating direction of the motor depends on the starter type parameter value.

6.3 Group Number

Function : Motor Grouping

Range : 1 (1) 9

Default setting : 1

Related parameters : Motor grouping / Group Identifier

Description :

The motors belonging to a specific group should be assigned the same number as the other group members.

6.4 Group ID

Function : Motor Grouping

Range : 16 characters

Default setting : GROUP1

Related parameters : Motor grouping / Group number

Description :

Group name is the name of the group to which the motors (M101-P/M102-P) belong. This name is used for visualisation purpose. This parameter can be used optionally and has no functional impact on the

Notes:

motor control unit. The motors belonging to a specific motor group are identified by the same name.

6.5 Group Start Delay

Function : Motor Grouping

Range : 0 (1) 300 s

Default setting : 0s

Related parameters : Motor grouping / Group start direction
Motor grouping / Motor startup time
Motor grouping / Group number

Description :

This is the delay for the start of the motor after receipt of the group start command.

6.6 Group Stop Delay

Function : Motor Grouping

Range : 0 (1) 300 s

Default setting : 0s

Related parameters : --

Description :

This is the delay for the stop of the motor after receipt of the group stop command.

7 Digital Inputs

The M101-P/M102-P has 13 programmable digital inputs for motor control and supervision. Each input can be configured with various functions according to the predefined list. These functions(Limit1, Limit2, PLC contact, F_CA, F_CB, F_CC, Loc/R, Main switch status, MCCB trip input) only can be assigned for one time at the same parameterization file. For each input, specific characteristic, such as Contactor Type, Delay etc., can be defined to different purposes.

The parameters under digital inputs are as below:

Function
Contactor Type
Operation Delay
Operation

7.1 Function

Function : Digital input

Range : NOP, Start1, Start2, Stop, Limit1, Limit2, Process interlock1, Process interlock2, Test Switch,, Emergency Stop, PLC control, Trip Reset, Torque Switch, F_CA, F_CB, F_CC, Loc/R, Main switch status, MCCB trip input.,

Default setting :

Digital Inputs	Default function
DI0	LIMIT1
DI1	LIMIT2
DI2	START1
DI3	START2
DI4	STOP
DI5	NOP
DI6	F_Ca
DI7	F_Cb
DI8	F_Cc
DI9	NOP
DI10	NOP
DI11	NOP
DI12	Main switch status

Notes:

Related parameter : Control Authority

Description :

Each digital input can be assigned to a specific function according to difference purpose.

NOP: Not special operation for the digital input, only for the check of digital input status.

Start1: The input is used to control motor to start via hardwire. Motor can be running CW/N1 via Start1.

Start2: The input is used to control motor to start via hardwire. Motor can be running CCW/N2 via Start2.

Stop: The input is used to control motor to stop via hardwire.

Limit1: That is limit position switch1 input.

Limit2: That is limit position switch2 input.

Process interlock1: The digital input is used to check the process interlock1 after motor is startup. For more details, please refer to M101-P/M102-P User Guide.

Process interlock2: The digital input is used to check the process interlock2 after motor is startup.**Test switch input:** The input is used to indicate whether the main switch is in the test –position. While in test position, M101-P/M102-P monitors the I/O statuses and phase currents/voltages. Contactor operations by M101-P/M102-P are allowed but all protection functions based on the current and voltage measurement are disabled and the test of control circuit is allowed.

Emergency Stop: If the input is defined as 'emergency stop', M102 will activate a stop command the motor after a high input is detected.

PLC Contact: M101-P/M102-P accepts the commands from PLC to control motor when programmable DI is configured as 'PLC Control'. When the PLC contact closes, the motor runs. When the contact opens, the motor stops. This input is only suitable for no-reversing starter.

Trip Reset: the input is used to reset after a trip.

Torque switch: The input is used to check the status of torque switch used for Actuator Starter. When the input is different from normal state, M101-P/M102-P will release all contactor control relays to stop the motor.

F_CA: That is contactor control A feedback.

F_CB: That is contactor control B feedback.

F_CC: That is contactor control C feedback.

Loc/R: That is Local/Remote control switch input.

Main switch status: That is auxiliary contact from main switch. It's used to indicate the status of main switch.

MCCB Trip Input: That is feedback contact when the circuit breaker tripped. Only use for the starter type ' Feeder'.

7.2 Contactor type

Function : Digital input

Range : NO/NC

Default setting : NO

Related parameter : Digital input / Function

Description :

This parameter is used to define the normal state of the input, Normally open or normally closed.

Digital Inputs have many functions for selection, and different functions have different characters. The below table shows the details.

Notes:

Trigger Mode	Digital Input Contactor type	Function	Description
Edge triggering	NO, NC	Start1	If the input status is deferent as the setting the function will be active
		Start2	
		Stop	
		Trip Reset	
	NO	PLC contact	Please see7.1
Level triggering	NO, NC	Process Interlock1	If the input status is the same as the setting the function will be active
		Emergency Stop	If the input status is deferent as the setting the function will be active
		Torque switch	
		Process Interlock2	
	NO	Test switch	If the input status is 'open' M102 is in the test position, whereas in the normal position
	NO, NC	NOP	Only detect the input status

Note:

i) When motor starter type is 'Actuator', one of Digital Inputs may be defined as 'Torque switch' input if needed. The wiring details pls refer to user guide.

ii) When one of Digital Inputs is defined as 'Process interlock1', the input is regarded as unhealthy if the high/low is detected as the same type as the preset contact type. i.e, If contact type is set as NO type, a low input will be regarded as unhealthy input. Therefore, with 'operation delay ' is set to 0', a motor start is prohibited if the unhealthy contact is detected.

iii) When one of Digital Inputs is defined as 'Emergency stop or Torque switch', the input is regarded as unhealthy if high/low input is detected as different from the setting contact type. i.e. If contact type set NO, a high input will be regarded as unhealthy input.

7.3 Operation delay

Function : Digital input

Range : 0-3600s

Default setting : 0s

Related parameter : Digital input / Function/process interlock1, process interlock2

Description :

For process interlock1, this parameter sets the amount of time that the Process interlock switch can remain open on the occurrence of a motor start. If the switch remains unhealthy for longer than this time, a trip/stop will occur. If this parameter is set to 0, that the process interlock switch must be healthy in order for M101-P/M102-P to allow the motor to start. For process interlock2, this parameter sets the amount of time that the process interlock switch can be unhealthy during normal running. If the switch remains unhealthy for longer than this time, a trip/stop will occur.

7.4 Operation

Function : Digital input

Range : Stop/trip only/ alarm only/ trip and alarm

Default setting : Stop

Related parameter : Function/process interlock1, process interlock2

Description :

this parameter determines whether process interlock feature is a trip(reset required in order to restart the motor) or a stop (no reset required) or an alarm(whenever the Process Interlock switch is unhealthy).

8 Programmable Outputs

Notes:

There are two separate programmable outputs in M102-P, and there only one programmable outputs in M101-P.These outputs can be assigned the different function.

The parameters under programmable outputs are as below:

Function

Start/Stop delay

8.1 Function

Function : Programmable Outputs

Range : Energize on start delay, De-energize on stop delay, Fieldbus control DI9 status, DI10 status, DI11 status, Trips, Ground fault trip, Overload Watchdog output, Communication failure, RCU Mode (only for M101-P), Local remote output (only for M102-P),

Default setting : Fieldbus control

Related parameter : Programmable outputs / Start/Stop delay

Description :

Energize on motor start delay : The output relay is energized with a delay when motor is started.

De-energize on motor stop delay: The output relay is de-energized with a delay when motor is stopped.

Fieldbus control: The relay can be energized or de-energized via the fieldbus.

DI9 Status : The relay will energize while DI9 switch is closed

DI10 Status: The relay will energize while DI10 is closed

DI11 Status: The relay will energize while DI11 switch is closed

Trips: The relay is energized when there is no trip. When a trip occurs, the relay will be de-energized. Resetting M101-P/M102-P will energize the relay.

Ground fault trip: The relay is energized when no ground fault trip occurs. When ground fault trip occurs, the relay will de-energized. Resetting M101-P/M102-P will energize the relay.

Overload: The relay is energized when no overload trip occurs. When overload trip occurs, the relay will de-energized. Resetting M101-P/M102-P will energize the relay.

Watchdog output: M101-P/M102-P has an internal hardware watchdog supervising the behavior of the microprocessor software. Programmable output can be used as signaling output relay for indicating the status of the unit's internal watchdog. In case of fault the watchdog activates and the relay is energized.

Communication failure: The relay is energized when no communication failure occurs. When the failure occurs, the relay will be de-energized.

RCU Mode (for M101-P): This definition is assigned to the programmable out when 'NR DOL/RCU ' or REV DOL/RCU is selected as motor starter mode. The relay output serves the same function of ' de-energized the contactor coil' as 'CCC' output in M102.

Local remote output(only for M102-P): The relay is energized when the control authority is Remote only .The relay will be de-energized when the control authority is Local and Remote or Local only.

8.2 Start/Stop delay

Function : Programmable Output

Range : 0-125s

Related parameter : Programmable Output / Function/Energize on motor start delay Programmable Output / Function/De-energize on motor stop delay

Description :

Refer to Chapter 8.1

Notes:

9 Thermal Overload Protection (TOL)

M101-P/M102-P protects the motor by calculating the thermal image of the motor both during running and stop. This image is used to allow optimal performance of the motor with calculated time to restart and time to trip.

The thermal image is calculated based on the highest of the three measured phase currents and depends on the parameterised data such as trip class (t6), motor ambient temperature (T_{AMB}), cool down time factor (M_{t6})

Motor ambient temperature is taken into account for thermal image calculation by means of a device internal parameter TFLC. Where, TFLC is the highest of the measured three phase currents related to motor ambient temperature.

When the thermal capacity level reaches 100%, the thermal overload trip will occur. The TOL trip can be reset after the thermal image goes below the motor reset level. The motor can be restarted only after TOL trip is reset.

When the motor is being stopped, the thermal image calculation continues by using the background heat level and cooling down time factor until thermal capacity level decreases to zero. The thermal capacity decreases at a constant rate till it reaches the background heat level, after which it depends on the parameters trip class, and cool down time factor. Thus, simulating cooling down of the stator winding and the iron body of the motor.

During power failure, the thermal capacity level of the motor is stored in the memory and the cooling down calculation starts from this level after resumption of power.

TOL Protection conforms to IEC 947-4-1, i.e with a motor current 1.05xTFLC running for 2 hrs will not cause TOL-trip and subsequent rise in current to 1.2xTFLC will cause trip within 2 hrs.

The time to trip calculation begin when the current is above 1.14xIn. The time to reset is calculated after TOL trip and is equal to zero when the thermal image reaches the reset level.

In case of unbalance situation, the fictitious negative sequence current in remaining phases is taken into TOL calculation to trip early.

Parameters involved in TOL protection are as below:

Function Disabled, Enabled

Thermal Model

Trip Class t6 (Standard model)

Trip Class te Time (EEx e model)

Ia/In Ratio (EEx e model)

TOL Alarm Level

Trip Reset Mode

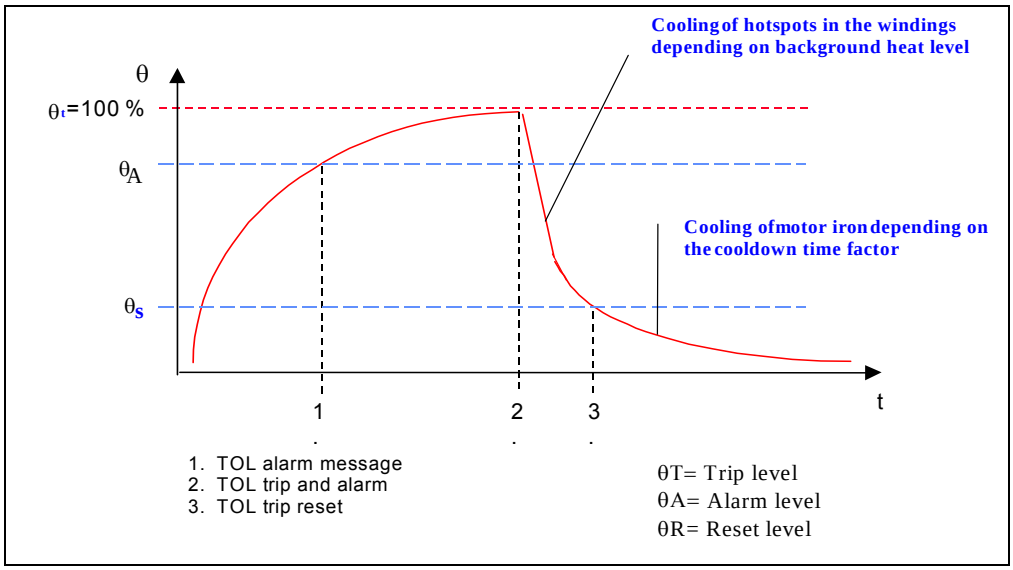
TOL Bypass Command (Standard model)

Cool Coe.

Ambient temperature

Notes:

Figure 1 Illustration of motor thermal simulation behavior



9.1 Function Enable, Disable

Function	:	TOL Protection
Range	:	Enabled / Disabled
Default setting	:	Enabled
Related parameter	:	TOL protection / Parameters
		Motor information / Motor startup time
		Motor information / Motor startup time N2
Description	:	

TOL protection function can be disabled with the help of this parameter. When disabled, all other parameters of the TOL function (trip reset mode, thermal model, TOL bypass, trip level, trip delay, T6, Te, cool coe. , Ia /In and temperature) do not have any functionality in the motor control unit.

This function is disabled automatically during the motor startup period.

9.2 Thermal Mode

Function	:	TOL Protection
Range	:	Standard / EEx e
Default setting	:	Standard
Related parameter	:	TOL protection / Parameters PTC protection / Trip Level, Reset Level Motor information / Motor Ambient Temperature
Description	:	

The thermal model can be selected as either standard or EEx e. The standard model makes use of trip class, startup I ratio and motor startup time in TOL calculation. Parameter trip class definition defines the trip time for 6x motor nominal current (In) and it must be less than defined cold state maximum value for the motor.

The protection of explosion proof three-phase induction motors with type of protection ‘increased safety’ EEx e is done with two special parameters, the stall/nominal current ratio (Ia/In ratio) and te time. The tripping time of the TOL protection from the cold state motor must be less than the te time rated for the motor.

For EEx e thermal model a set of parameters have fixed values or are not available in order to simplify parametering instructions and parametering process while providing a secured protection functionality.

Notes:

This should be carefully considered by the user since the given parameter value do not have effect to functionality in this case.

These are following parameters are not available when EEx e mode is selected:

Motor information / Motor ambient temperature : Fixed 40°C

TOL Protection / TOL bypass command : Disabled

9.3 Trip Class (T6)

Function : TOL Protection

Range : 3 (1) 40 s

Default setting : 6s

Related parameter : TOL Protection / Thermal Model (standard)
Motor Information / Nominal Current (In)
Motor information / Motor Ambient Temperature

Description :

Parameter trip class (t6) is the basic setting of the thermal protection function. For user it provides the possibility to set the thermal model characteristic according to motor startup requirements and characteristic. With trip class parameter user defines the time that protection allows current of 6x In from cold condition for protected motor.

Motor start-up is the most common occurrence of the short overload situations. Normally two starts from cold condition and one start from a hot condition are permitted. The Trip class (t6) value can be set according to one cold start, which allows easy setting of protection.

The Trip class (t6) time for protection is defined based on the motor maximum start time, which is informed by the manufacturer.

Initial information required for Trip class (t6) definition.

– Motor startup current ratio (rated motor data, Is/In), see parameterStartup I ratio

– Maximum start time permitted for cold motor

– Maximum start time permitted for warm motor

– Motor ambient temperature, see parameter Motor ambient temperature.

Example 1. A thermal protection is set for a motor M2BA315SMC, 110 kW.

– Motor startup current ratio (Is/In) 7,5

– Maximum start time for cold motor 30 s

– Maximum start time for warm motor 15 s

– Motor ambient temperature 40°C

With the initial information the protection characteristic can be defined by the following procedure. First, the motor start current is calculated according to the ambient temperature. Practically, with 40°C of ambient temperature, the following calculation for start current can be passed. For more information of ambient temperature coefficient see table of maximum permitted current in chapter ”Ambient Temperature”.

Temperature coefficient is derived with the following routine. Since the motor ambient temperature in the example is 40°C, the TFLC is 1.00 x In.

Motor startup current ratio is 7.5, thus motor rated start current (Is) is:

$$Is = {Is}/{In} \times In$$

The effect of ambient temperature is derived, when Is and TFLC are known:

$$\frac{Is}{TFLC} = \frac{7.5 \times In}{1.00 \times In} = 7.5$$

The calculated start current ratio (7.5) and motor maximum start time (30 second) are placed on the cold condition time/current characteristic diagram. Start current ratio is located on the horizontal axis, while the maximum permitted time for cold motor start is set on the vertical axis. The cross point of these

Notes:

constraints shows the maximum setting for Trip class (t6).

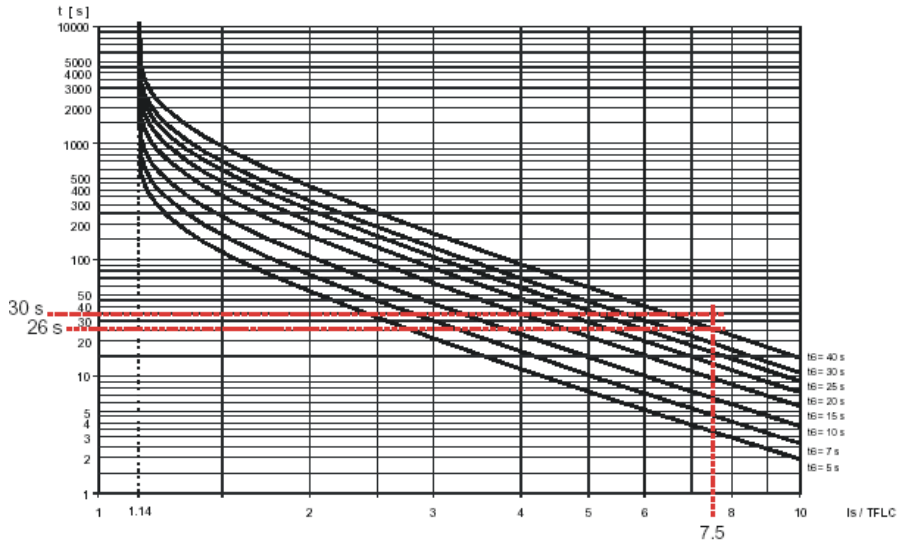
The received setting is the absolute maximum value without further considerations and a lower value can be selected. A longer start is not protected by thermal protection and additional protection against stalled rotor is necessary. In case of thermal protection trip at start, with the setting of maximum Trip class (t6) value, it is recommended to check the motor size for extreme start requirement.

Now, the setting of 40 second is limited by the range of parameter. Value for Trip class (t6) is derived from the cold condition time/current diagram, see the picture. This setting allows start time up to approx. 26 second for cold motor, before a thermal protection trip occurs. The start time for a warm motor, with this parameter setting, can be read from the hot condition time/current diagram accordingly. The check routine is shown in the latter picture.

The warm condition start must be within motor ratings. In this case, the start time for a warm motor is approximated from the latter picture and must be shorter than 12 second, as read from the picture. In practice, start lasting longer than 12 second, will lead to trip from the thermal protection.

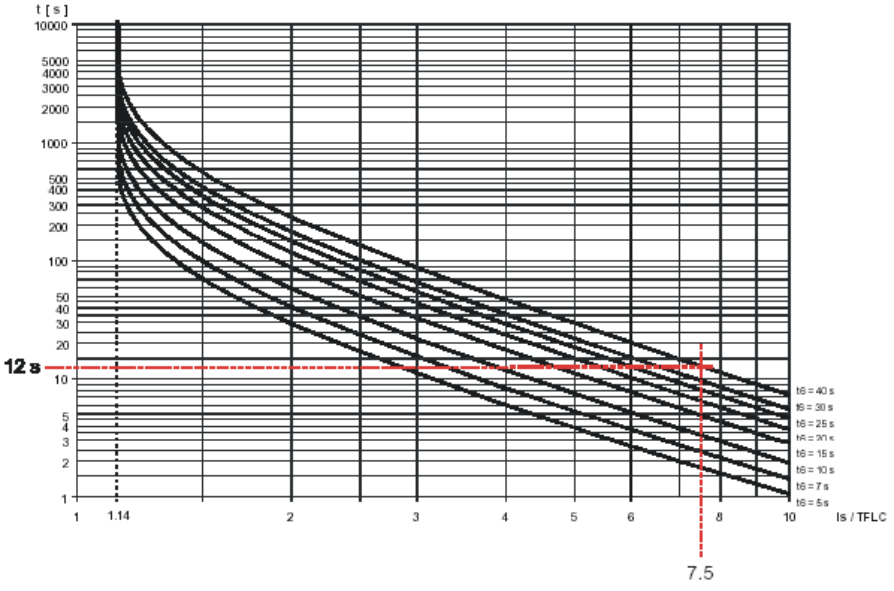
Figure 2 Trip class (t6) definition from cold condition time/current diagram

Diagram presented in 40°C Motor ambient temperature



.**Figure 3** Start time vs. Trip class (t6) definition from hot condition time/current diagram

Diagram presented in 40°C Motor ambient temperature



Notes:

More optimised setting of the thermal protection is needed in case of one start for warm motor is required. In this case the *Trip class (t6)* parameter is derived from the warm condition time/current diagram according to actual duration of motor start and motor startup current.

The derived *Trip class (t6)* value is verified from the cold condition time/current diagram to ensure that thermal protection trip time is less than maximum allowed start time for a cold motor, i.e. the protection is well defined.

There is a need to arrange a separate protection for unsuccessful start, i.e. stalled rotor, if the thermal protection characteristic allows longer start before trip than is allowed for the motor. Then stall protection is utilised for a cold motor start supervision. By defining the operation of *Startup time* and stall protection *Trip delay* the trip must be set before motor maximum start time is exceeded, in case of unsuccessful start.

9.4 Trip class (te)

Function	:	TOL protection
Range	:	1 (1) 250 sec
Default setting	:	5s
Related parameter	:	TOL protection / Thermal model (EEx e)
		TOL protection / Ia/In ratio
		Motor information / Motor ambient temperature
Description	:	

The safe locked rotor time te of a particular induction motor is the time necessary for the winding temperature to rise from its final operational value to a fixed maximum value determined by the corresponding temperature class of the motor during locked rotor. It is of particular significance when the overload protection is specified for motors destined for use in hazardous locations. The te-time is for EEx e motors to withstand Ia/In current.

The parameter value for trip class te time is as rated for EEx e motor in the data book which represents the maximum value. Parametrised value for trip class te time can be equal or less than motor rated te time. For a faster trip value less than rated is selected.

With Ia/In ratio this parameter makes it possible for M101-P/M102-P unit to calculate the trip time of the motor according to the load. M101-P/M102-P calculates the trip time for EEx e motor automatically, but the trip time for a certain current for further investigation can be defined as presented in this chapter.

Trip time can be defined with the help of following cold condition time/current diagram. Diagram is according to TOL standard model cold condition.

Initial information, as parametrised, is required.

Ia/In ratio for EEx e motor

te time for EEx e motor

When Ia/In ratio is placed on the current (Is/TFLC) axis and te time is placed on the time (t) axis, the co-ordinate on which the lines drawn through these points cross each other is located on the t6 curve. According to defined t6 curve trip time vs. motor current are available from cold condition time/current diagram. The same t6 curve can be used for defining the trip time from a hot condition time/current diagram, as well.

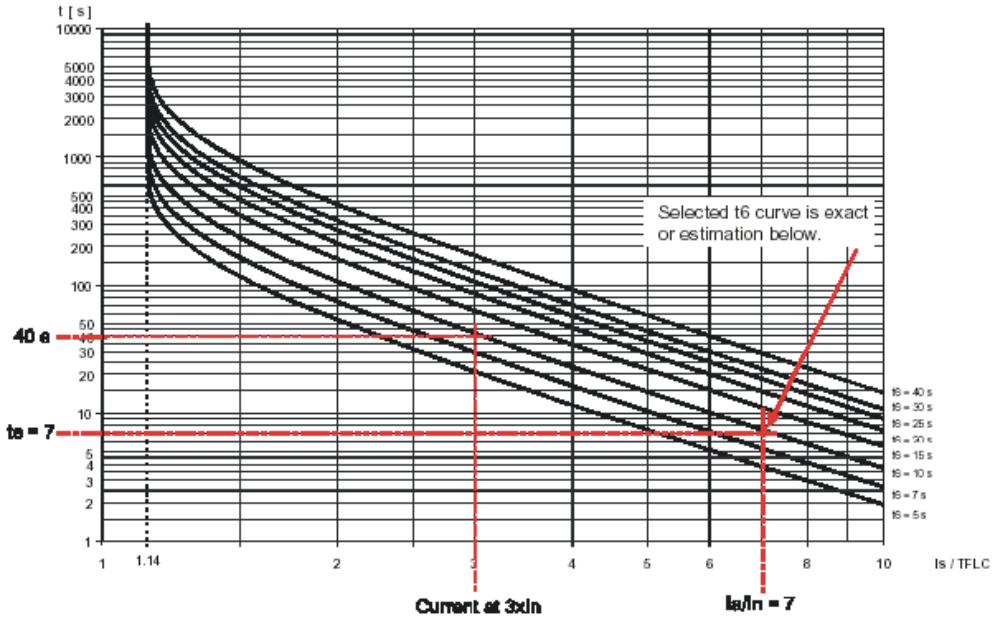
For example: Ia/In ratio for EEx e motor is 7 and parameter te time value is 7 seconds. By using the following cold condition time/current diagram t6 curve can be found. When t6 curve is defined other trip times vs motor current are available.

Motor ambient temperature is not observed because it does not have affect in TOL EEx e module usage, thus Ia/In can directly be used (see parameter Ambient temperature).

The readout is t6 curve which is either existing in the diagram or is an estimation below the defined point. In this case Trip class (t6) = 9 seconds is estimated from the example picture below and is drawn to the diagram. Trip time for current 3xIn is estimated approx. 40 seconds.

Notes:

Figure 4 Trip class definition for TOL/EEx e model from cold condition with time/current diagram
Diagram presented in 40°C Motor ambient temperature.



9.5 Ia/In

Function : TOL protection

Range : 1.2 (0.1) 8

Default setting : 5

Related parameter : TOL protection / Thermal model (EEx e)
TOL protection / Trip class te time

Description :

It is the ratio of stall current to the nominal current for EEx e application. The motor shall withstand this current for the duration trip class te time.

This information is rated for EEx e motor and available in motor data sheet.

9.6 TOL Alarm Level

Function : TOL Protection

Range : 60 (1) 100%

Default setting : 90%

Related parameter : --

Description :

When the motor thermal level reaches thermal capacity level set by this parameter, the M101-P/M102-P sends a warning “TOL Alarm”. The TOL alarm is automatically reset when the thermal capacity reaches the parameterised TOL alarm level again.

An “O/L alarm” and the time to trip is reported when the motor current exceeds 1.14 x In. The time to reset becomes zero when the reset level is reached.

9.7 TOL Trip Level

Function : TOL Protection

Range : 60 (1) 100%

Notes:

Default setting : 100%

Related parameter : --

Description :

When the motor thermal level reaches thermal capacity level set by this parameter, M101-P/M102-P issues a trip command to stop motor with a message 'TOL Trip'.

9.8 TOL Reset Level

Function : TOL Protection

Range : 10 (1) 60%

Default setting : 50%

Related parameter : --

Description :

Following a TOL trip, the thermal capacity of the motor is descreasing. Until the motor thermal level reaches thermal capacity level set by this parameter, TOL trip cannot be reset. Nor can restart the motor before resetting.

9.9 Trip Reset Mode

Function : TOL Protection

Range : Auto / Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Programmable inputs / Function

Description :

TOL trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the fault as desired by parameterisation.

Auto Reset: Trip resets automatically after the calculated thermal capacity attains the reset level (time to reset reaches 0).

Remote Reset: Trip reset is only possible after the calculated thermal capacity attains the reset level via the fieldbus .

Local Reset: Trip reset is only possible after the calculated thermal capacity attains the reset level via Digital Input which is assigned for 'Reset' (or via operator panel MD).

9.10 TOL Bypass Enable/Disable

Function : TOL protection

Range : Enabled / Disabled

Default setting : Disabled

Related parameter : TOL protection / Thermal model (standard)

Description :

The operation of the TOL protection function can be prevented by a special 'TOL bypass' command given via the fieldbus when the thermal level rises over the TOL alarm level. With the TOL bypass feature the thermal level can be raised up to 200 % after which a trip will be executed. The possibility for execution of this command is enabled by this parameter.

If there is no trip, the TOL bypass command sent before is automatically deactivated when the thermal capacity decreases below the TOL alarm level.

An emergency restart is possible with the thermal capacity being above the startup inhibit level by issuing a start command immediately after TOL-bypass command. TOL-bypass command cannot be enabled when the EEx e parameter is active.

Note: TOL Bypass function can't be available for Profibus-DPV0.

9.11 Cooling Coe. (Mt6)

Function : TOL Protection

Notes:

Range : 1 (1) 10

Related parameter : --

Description :

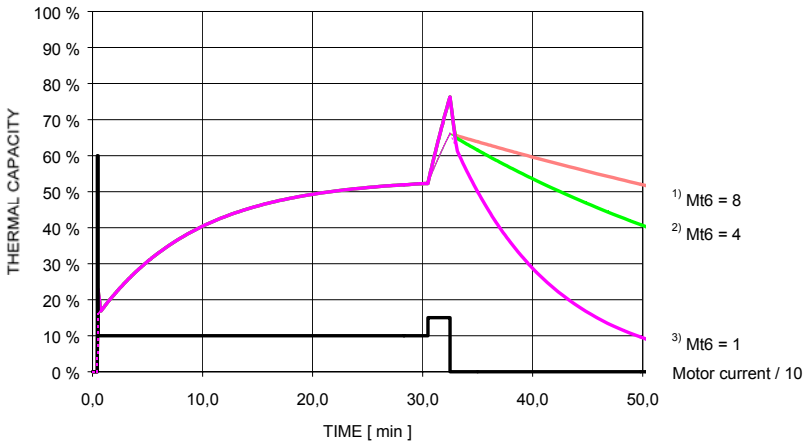
For an accurate thermal image of the motor, M101-P/M102-P needs to know the characteristics of the motor to be controlled. Different motors in different environments need different time periods to warm up and to cool down. The cooling down period for a stopped motor is usually about four times longer than the warm up period and it certainly differs within the motor, e.g. in certain hot spots of the windings from the iron core. But this value can be different depending on dirt or other material covering the motor, motor body size, weight installation place, etc.

The normal value for the parameter is between 4…8 descriping the slower cooling for a stopped motor [curve 1 and 2] than cooling of a running motor [curve 3]. In practise, this has been discovered as the normal rule for motors covering various applications.

However, if motor manufacturer gives recommendation for another value, it may be set to the protection.

For example: External cooling system is installed for improving the cooling down of a stopped motor. Furthermore, according to statement from motor manufacturer cooling time constants for a running and stopped motor are equal. Thus the parameter can be set below recommended value 4 [curve 1].

Figure 5 Cooling Coe. (Mt6) parameter influence on stopped motor cooling (principle picture)



9.12 Ambient Temperature

Function : Motor information

Range : 0 (5) + 80°C

Default setting : 40°C

Related parameter : TOL protection / Thermal model
Motor information / Nominal current
TOL protection / Trip class
TOL protection / Trip class te time
TOL protection / TOL, and O/L Alarm

Description :

Motors of basic design are intended for operation in a maximum ambient temperature of 40°C. If a motor is to be operated in higher ambient temperature, it should normally be derated and should not be loaded to the same thermal capacity. Normally this reduction of output power is done automatically by M101-P/M102-P but it is also possible to do it manually which is instructed later in this chapter.

To calculate the thermal image of the motor being protected, the M101-P/M102-P needs to know the temperature of the environment in which the motor is running. Especially in industries, where the motors are located near the heat source, the maximum thermal capacity level of the motor is reduced based on

Notes:

the increased surrounding temperature.

Motors designed for EEx e applications are always rated and certified for a certain maximum ambient temperature, most commonly 40°C. If EEx e motor is designed for other temperature manufacturer will supply the motor rated data.

Because of the nature of EEx e motor the output power ratings are not reduced automatically according to ambient temperature by M101-P/M102-P. Instead of using ambient temperature parameter M101-P/M102-P uses fixed value 40°C, thus multiplier is one (1) when TOL EEx e model is selected.

The M101-P/M102-P reduces the maximum permitted current by the multiplier as indicated in the table below (TOL standard model).

Ambient temp. °C	40	45	50	55	60	65	70	75	80	Ambient temp. °C
Permitted current = In x	1.00	0.96	0.92	0.87	0.82	0.74	0.65	0.58	0.50	Permitted output, % of rated output

For example: The thermal capacity level of the motor reduces from 100% at 40°C to 85% at 50°C. Therefore, the motor can be loaded maximum to 92% of its rated load at 50°C.

Manual reduction may be needed if other reduction multiplier than presented in the table above are required. Output power reduction is done by setting the value 40°C to parameter motor ambient temperature and calculating the temperature reduction directly to nominal current. When multiplier is calculated this way it must be applied to trip class time as well (Is/TFLC).

For example: Motor data sheet specifies that in 60°C motor can be loaded maximum of 75% of the nominal. Thus motor ambient temperature is set to 40°C and when setting the nominal current the rated motor current is derated,

$$nominal\ current = 0.75 x In$$

When nominal current is derated trip class parameter is defined with the same factor. It should also be considered that other parameter's, i.e. protection function trip and alarm levels, referring to nominal current are effected relatively.

10 Stall Protection

Stall protection is used to protect the driven mechanical system from jams and excessive overloads. Under such conditions, the motors have to be switched off in good time and reported to avoid undue mechanical and thermal stress on the motor and the installation.

This protection function is active only after the motor has successfully started or after parameterised motor startup time has elapsed and will cause relay activation in case of a motor stall while it is running.

The parameter can be set to a higher value for application experiencing overload as part of normal operation.

Note: Large low-voltage motors and those# having short admissible stalling time less than the startup time are not protected by this function.

- Mixers, crushers, saw cutters etc.

Stall protection function consists of following parameters:

Function Enable, Disable

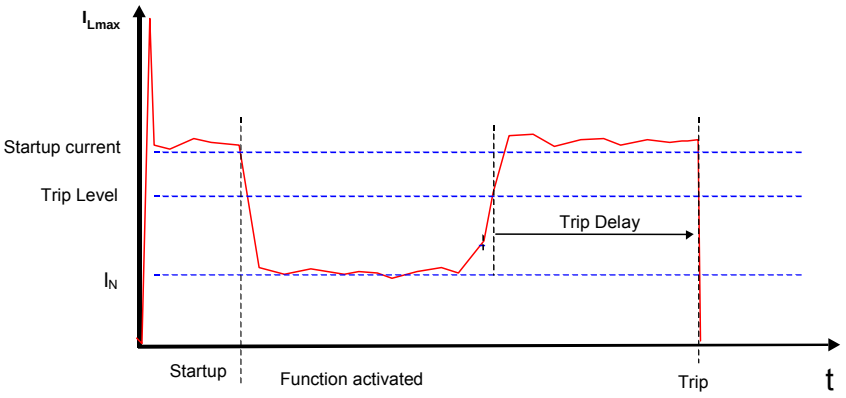
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 6 Stall protection function



10.1 Function Enable, Disable

Function	:	Stall Protection
Range	:	Enabled / Disabled
Default setting	:	Disabled
Related parameter	:	Stall protection / Parameters
		Motor information / Motor startup time
		Motor information / Motor startup time N2
Description	:	

Stall protection function can be disabled with the help of this parameter. When disabled, all other parameters of the stall function (trip level, trip delay and trip reset mode) do not have any functionality in the motor control unit.

Stall protection activates after motor startup and either of below two conditions is fulfilled:

motor have succesful start, i.e. current has decreased under 1,25 x In after current inrush

time specified by motor startup time parameter has elapsed

10.2 Trip Level

Function	:	Stall Protection
Range	:	120 (10) 800%
Default setting	:	400%
Related parameters	:	Stall protection / Function enable, disable
		Stall protection / Trip delay
Description	:	

When the highest of the measured phase currents remains above the set value for a trip delay time, the M101-P/M102-P will perform a trip with a message ‘Stall trip’. If normal conditions are restored before the trip delay elapses, the M101-P/M102-P will go back to normal operation.

The trip level referenced to In shall be set based on the motor technical data sheet supplied by the manufacturer and the requirements / restrictions of the application.

10.3 Trip Delay

Function	:	Stall Protection
Range	:	0.0 (0.1) 25.0 s
Default setting	:	0.5s
Related parameters	:	Stall Protection / Function Enable, Disable

Notes:

Stall protection / Trip level

Description :

When the condition for a stall trip is present, the M101-P/M102-P will start a count down for the time specified in *trip delay* parameter. The trip is followed with a message 'Stall Trip'. The *trip delay* shall be set based on the requirements / restrictions of the application.

10.4 Trip Reset Mode

Function : Stall Protection

Range : Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Stall protection / Function enable, disable

Programmable inputs / Function

Description :

Stall trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by parameterisation.

Remote Reset: Trip reset is only possible via the fieldbus.

Local Reset: Trip reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD) .

11 Phase Failure Protection

Phase failure in motor phase currents is a common phenomenon in industrial environment. It generally occurs because of pitted contacts in the contactor or SCPD, imbalance in the mains supply, loose connections, blown fuse, and faults within the motor. It is an extreme situation where a complete loss of phase occurs. This can be caused by a utility supply problem or by a blown fuse in one phase. Unbalanced phase currents are a major cause of motor thermal damage due to the nature of the current. The negative sequence current induced in the rotor is of double the power supply frequency and produces a counter torque to the desired motor output. For small unbalances, the overall output torque will remain same as motor develops a large positive sequence torque to overcome the negative sequence torque. This opposing torque and the high negative sequence current lead to an increased temperature rise in the rotor and stator.

Reasons for the phase failure are neither temporary nor self-covering. Although TOL protection performs an accelerated trip during phase failure and unbalance over 20%, there are no good reasons to wait for the trip to occur through TOL protection. By the use of phase failure protection a motor can be tripped without waiting for thermal calculation. Indeed, phase failure protection should be parameterised to trip in shorter time than TOL does.

Parameters involved in Phase failure protection are as below:

Function Enabled /Disable

Alarm Level

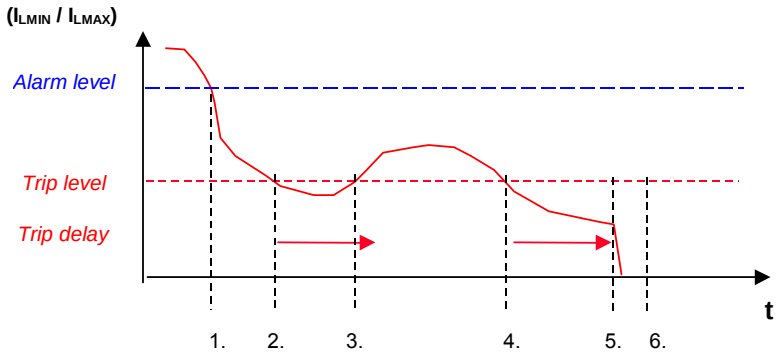
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 7 Phase failure protection



1. Alarm message
2. Trip delay active
3. Trip delay cleared
4. Trip delay active
5. Contactor trip and trip message
6. Reset according to reset mode

11.1 Function Enable, Disable

Function	:	Phase Failure Protection
Range	:	Enabled / Disabled / Alarm only
Related parameter	:	Phase Failure Protection / Parameters
		Motor information / Startup Time
		Motor information / Startup Time N2
		Motor information / Ramp Time
		Motor information / Motor type
Description	:	

Phase failure protection function can be disabled with the help of this parameter. When disabled, protection function does not have any functionality in the M101-P/M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

This function is disabled automatically in the case of single-phase motor and during the motor startup period.

11.2 Alarm Level

Function	:	Phase Failure Protection
Range	:	10 (1) 90%
Default setting	:	80%
Related parameters	:	Phase failure protection / Function enable, disable
Description	:	

To avoid motor failure by phase failure, the M101-P/M102-P calculates the ratio between the lowest phase current to the highest phase current (I_{LMIN} / I_{LMAX}) from the measured currents of all three phases. If the condition set by this parameter is true, There will be a ‘Phase Failure Alarm ’ warning message. The ‘Phase Failure Alarm’ clears automatically on restoration of normal condition.

11.3 Trip Level

Function	:	Phase Failure Protection
Range	:	5 (1) 90%
Default setting	:	70%
Related parameters	:	Phase Failure Protection / Function Enable, Disable

Notes:

Phase Failure Protection / Trip delay

Description :

When the ratio I_{LMIN} / I_{LMAX} corresponds to the value set on trip level, the M101-P/M102-P will trip after the elapse of trip delay time with a message 'Phase Failure Trip'. If normal conditions are restored before the trip, the M101-P/M102-P will go back to normal operation.

11.4 Trip Delay

Function : Phase Failure Protection

Range : 0 (1) 60 s

Default setting : 10s

Related parameters : Phase Failure Protection / Function Enable, Disable

Phase Failure Protection / Trip Level

Description :

After trip level condition is reached, the M101-P/M102-P will delay the trip for the time defined by pre-parameterised trip delay. A message 'Phase failure trip' is generated. With this delay, a short phase current loss can be filtered. The M101-P/M102-P can be reset according to the trip reset mode parameter.

11.5 Trip Reset Mode

Function : Phase Failure Protection

Range : Remote, Local, Remote & Local

Default setting : Remote & Local

Related parameter : Phase Failure Protection / Function Enable, Disable

Description :

Phase failure trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by suitable parameterisation.

Remote Reset: The "Phase failure trip" reset is only possible via the fieldbus.

Local Reset: Phase failure trip reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD).

12 Unbalance Protection

Unbalance protection function protects the motor against a small degree of unbalance in the motor phases. The function monitors the ratio between I_{LMIN}/I_{LMAX}. The calculation of the motor thermal capacity takes into account the unbalance for early tripping to prevent motor damage due to negative sequence currents. For more information refer to Phase Failure Protection.

Parameters involved in unbalance protection are as below:

Function Enable, Disable

Alarm Level

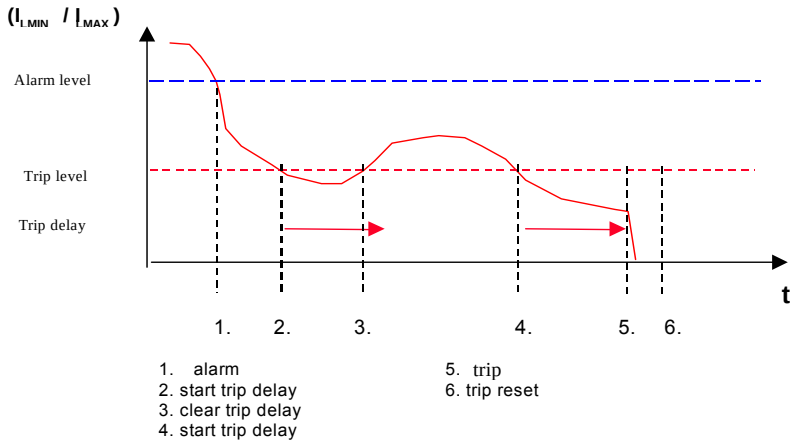
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 8 Unbalance protection



12.1 Function Enable/Disable

Function	:	Unbalance protection
Range	:	Enabled / Disabled / Alarm only
Default setting	:	Disabled
Related parameter	:	Unbalance protection / Parameters Motor Information / Number of phases (3 phase applications) Motor information / Motor startup time Motor information / Motor startup time N2
Description	:	

The unbalance protection function can be disabled with the help of this parameter. When disabled, the protection function does not have any functionality in the M101-P/M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

This function is disabled automatically in the case of single-phase motor and during the motor startup period.

12.2 Alarm Level

Function	:	Unbalance protection
Range	:	50 (1) 90 %
Default setting	:	90%
Related parameter	:	Unbalance / Function Enable, Disable, Alarm only
Description	:	

To avoid a motor failure by phase unbalance, the M101-P/M102-P calculates a ratio between the lowest phase current to the highest phase current (I_{LMIN}/I_{LMAX}) from the measured currents of all the three phases. If the condition set by this parameter is true, there will be an ‘Unbalance Alarm’ warning message.

The “Unbalance alarm” clears automatically after normal status is attained.

12.3 Trip Level

Function	:	Unbalance protection
Range	:	50 (1) 90 %
Default setting	:	85%
Related parameter	:	Unbalance / Function Enable, Disable, Alarm only Unbalance / Trip delay

Notes:

Description :

When the ratio 'I_{LMIN}/I_{LMAX}' corresponds to the value set for this parameter, M101-P/M102-P will start a countdown set by trip delay parameter after which a trip occurs with a message 'Unbalance Trip'. If normal conditions are restored before the trip, the M101-P/M102-P will go back to normal operation.

12.4 Trip Delay

Function : Unbalance protection

Range : 0 (1) 60 sec

Default setting : 10s

Related parameter : Unbalance / Function Enable, Disable, Alarm only
Unbalance / Trip level

Description :

After the trip level level is reached, the M101-P/M102-P will delay the trip for the time set by this parameter. After the set trip delay, the M101-P/M102-P will trip the motor and give a message 'Unbalance trip'. With this delay, short phase unbalances can be filtered. The M101-P/M102-P can later be reset according to the trip reset mode parameter.

12.5 Trip Reset Mode

Function : Unbalance protection

Range : Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Unbalance protection / Function Enable, Disable, Alarm only

Description :

A phase unbalance trip can be reset in multiple ways. Depending on the control philosophy, it is possible to reset the trip as desired by suitable parameterisation.

Remote Reset: Unbalance trip reset is possible via the fieldbus.

Local Reset: Unbalance trip reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD).

13 Underload Protection

Underload protection function monitors the process against loss or decrease in motor load. This protection function is current based protection. It is especially useful for indication of loss of suction for pumps, broken belt for conveyors, loss of airflow for fans, broken tools for machines etc. Such states do not harm the motor but early diagnosis helps to minimise the extent of damage to the mechanical installation and subsequent loss of production.

The motors on underload draw mainly the magnetising current and a small load current to overcome frictional losses. Therefore, the other reason to isolate the motors on underload is to reduce the reactive load on the power system network.

Underload protection function is based on the highest measured phase current.

Parameters involved in underload protection are as below:

Function Enable/Disable

Alarm Level

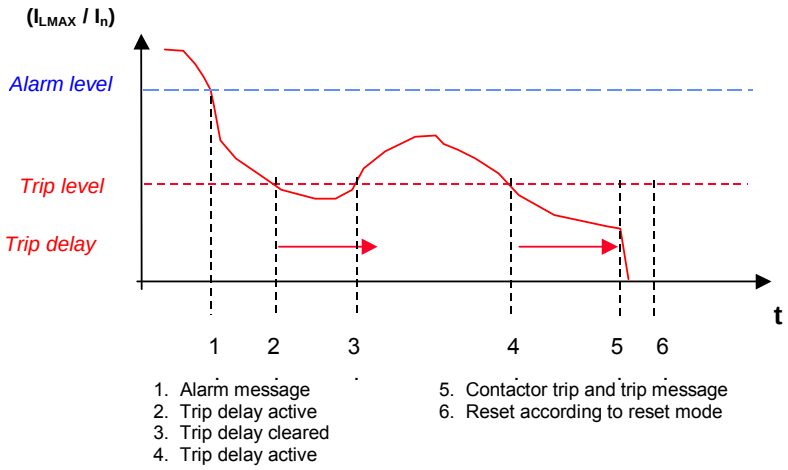
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 9 Underload protection



13.1 Function Enable/Disable

Function	:	Underload Protection
Range	:	Enabled / Disabled / Alarm only
Default setting	:	Disabled
Related parameter	:	Motor information / Ramp-up time Motor information / Ramp-down time Motor information / Startup Time (Autotrafo)
Description	:	

Underload protection function can be disabled with the help of this parameter. When disabled, protection function does not have any functionality in the M101-P/M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

In the Startup time of Softstarter/Autotransformer, underload protection is suppressed.

13.2 Alarm Level

Function	:	Underload Protection
Range	:	20 (1) 90%
Default setting	:	30%
Related parameters	:	Underload protection / Function
Description	:	

If the highest phase current (I_{LMAX}) of the measured three phase currents is detected below the alarm level, then a warning message “Underload Alarm” is created to inform the operator of the underload condition.

“Underload Alarm” clears automatically on restoration of normal condition.

13.3 Trip Level

Function	:	Underload Protection
Range	:	5 (1) 90%
Default setting	:	20%
Related parameters	:	Underload protection / Function Underload protection / Trip delay
Description	:	

Notes:

When current I_{LMAX} reaches the trip level, the M101-P/M102-P trips the motor after elapse of trip delay time. A message 'Underload Trip' is generated after the trip. If normal conditions are restored before the trip, the M101-P/M102-P will go back to normal operation.

13.4 Trip Delay

Function	:	Underload Protection
Range	:	0 (1) 1800 s
Default setting	:	10s
Related parameters	:	Underload protection / Function
		Underload protection / Trip level
Description	:	

The trip is delayed by the time set by this parameter. If underload condition is not back to normal before the elapse of trip delay time, a trip is generated with a message. With this delay, short underload situations can be filtered.

13.5 Trip Reset Mode

Function	:	Underload Protection
Range	:	Remote / Local / Remote & Local
Default setting	:	Remote & Local
Related parameter	:	Underload protection / Function
Description	:	

Underload trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by suitable parameterisation.

Remote Reset: The "Underload Trip" reset is possible via the fieldbus.

Local Reset: The "Underload Trip" reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD).

14 Noload Protection

The noload protection function protects the process against sudden loss of load. Though this condition does not harm the motor, but requires a switch off to safe guard the process.

The no load current is of the order of 0.2 to 0.6 In depending on the size and speed of the motor. The no load current of slow speed motors is high and that of large motors is low.

The noload protection function is based on the highest phase current measured by the current measurement unit. The noload protection function detects missing current with respect to the contactor and the main switch ON feedback and executes actions as parameterised.

Parameters involved in noload protection are as below:

Function Enabled /Disable

Alarm Level

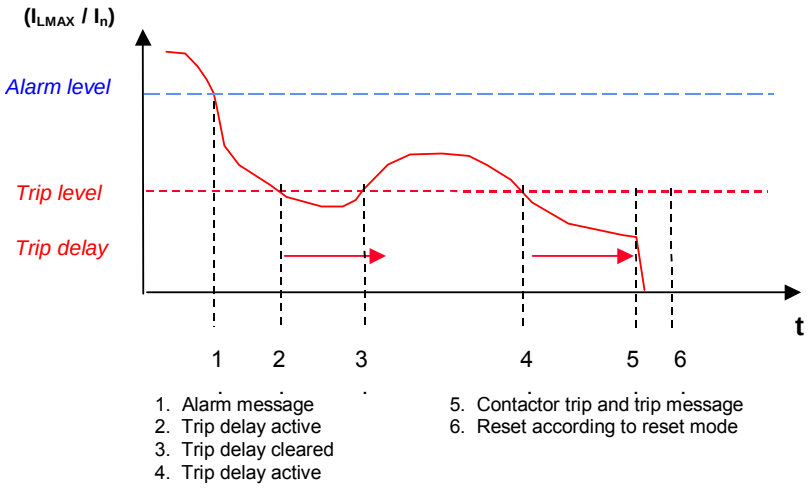
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 10 Noload protection



14.1 Function Enable/Disable

Function : Noload Protection

Range : Enabled / Disabled / Alarm only

Default setting : Disabled

Related parameter : No load / Parameters

Description :

No Load protection function can be disabled with the help of this parameter. When disabled, protection function does not have any functionality in the M101-P/M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

This function is disabled automatically in the case of single-phase motor and during the motor startup period.

14.2 Alarm Level

Function : Noload Protection

Range : 5 (1) 50%

Default setting : 20%

Related parameter : Noload protection / Function

Description :

If the highest phase current (I_{LMAX}) of the measured three phase currents is detected below the alarm level, then a warning message 'Noload Alarm' is created to inform the operator of the no load condition.

"Noload Alarm" clears automatically on restoration of normal condition.

14.3 Trip Level

Function : Noload Protection

Range : 5 (1) 50%

Default setting : 15%

Related parameters : Noload protection / Function
Noload protection / Trip delay

Description :

If the highest phase current (I_{LMAX}) of the measured three phase currents falls below the trip level for

Notes:

longer than the time period set by the trip delay, the M101-P/M102-P trips the motor with a 'Noload Trip' message.

14.4 Trip Delay

Function	:	Noload Protection
Range	:	0 (1) 1800 s
Default setting	:	5s
Related parameters	:	Noload protection / Function
		Noload protection / Trip level
Description	:	

When the current I_{LMAX} reach the no load trip level, the M101-P/M102-P trips the motor after elapse of trip delay time. A message 'Noload Trip' is generated after the trip. If normal conditions are restored before the trip, the M101-P/M102-P will go back to normal operation. With this delay, a short noload situations can be filtered.

14.5 Trip Reset Mode

Function	:	Noload Protection
Range	:	Remote / Local / Remote & Local
Default setting	:	Remote & Local
Related parameter	:	No load protection / Function
Description	:	

The noload trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by suitable parameterisation.

Remote Reset: Noload trip reset is possible via the fieldbus.

Local Reset: Noload trip reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD.

15 Earth Fault Protection

The earth fault protection function protects the motor and the network against ground current flow. During earth fault, the motors can reach a dangerous potential above the ground level thus posing safety hazard to personnel. The earth faults are mainly caused due to ageing of the insulation, deterioration of insulation due to sustained or cyclic overloading, moisture or conductive dust. Most insulation faults result in leakage to the frame of the motor. The monitoring of the earth faults is done with a residual current transformer.

The residual current transformer method is normally employed for either isolated systems or for systems earthed with high impedance. The sensitive protection against earth faults is possible. The low current threshold helps to protect the stator winding from earth faults at the neutral end.

The earth fault protection is supressed during starting to avoid nuisance tripping due to harmonics caused by saturation of the current transformers.

Parameters involved in the earth fault protection are as below:

Function Enable/Disable

Alarm Level

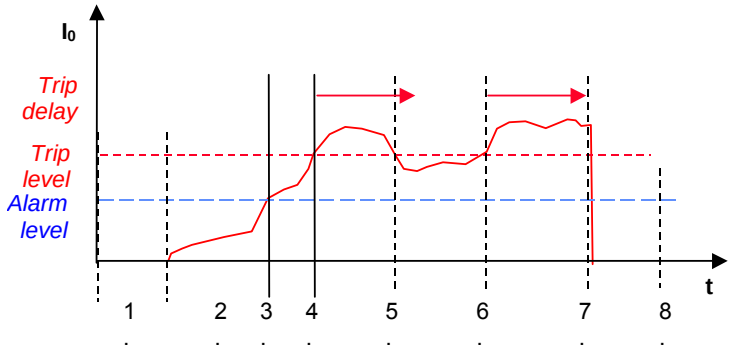
Trip Level

Trip Delay

Trip Reset Mode

Notes:

Figure 11 Earth fault protection



1. Motor startup time
2. Normal operation (Earth fault protection active)
3. Alarm message
4. Trip delay active
5. Trip delay cleared
6. Trip delay active
7. Contactor trip and trip message
8. Reset according to reset mode

15.1 Function Enable/Disable

Function	:	Earth fault protection
Range	:	Enabled / Disabled / Alarm only
Default setting	:	Disabled
Related parameter	:	Earth Fault Protection / Parameters
		Motor information / Motor startup time
		Motor Information / Number of phases (3 phase applications)
Description	:	

Earth fault protection function can be disabled with the help of this parameter. When disabled, the protection function does not have any functionality in the M101-P/M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

Protection function is disable during motor start specified by motor startup time parameter and also when single phase application is implemented.

15.2 Alarm Level

Function	:	Earth fault protection
Range	:	100(100)3000mA(Earth fault primary: 1A) or 500(100)15000mA(Earth fault primary: 5A)
Default setting	:	500mA
Related parameter	:	Earth fault / Function
Description	:	

When the earth fault current exceeds the pre-set level, an alarm “Earth fault alarm” is generated. The earth fault alarm is automatically reset when the current falls below the alarm level.

This function can be bypassed during the startup of a motor by parameterisation of a “trip delay”.

15.3 Trip Level

Function	:	Earth Fault Protection
Range	:	100(100)3000mA(Earth fault primary: 1A) or 500(100)15000mA(Earth fault primary: 5A)
Default setting	:	800mA
Related parameter	:	Earth Fault Protection / Function

Notes:

Earth Fault Protection / Trip delay

Description :

When the earth fault current remains above the 'trip level' for a pre-set trip delay time, the M101-P/M102-P will generate a trip command with a message 'Earth fault trip'. If normal conditions are restored before the trip delay time elapses, the M101-P/M102-P will go back to normal operation.

15.4 Trip Delay

Function : Earth Fault Protection

Range : 0.2 (0.1) 60 sec

Default setting : 10s

Related parameter : Earth fault / Function

Earth fault / Trip level

Description :

When the earth fault current rises above the trip level, the M101-P/M102-P will execute a trip command after elapse of the time specified in the trip delay parameter. The trip is followed with a message "Earth Fault Trip". The count down is reset if the earth fault current goes below the trip level before the pre-set trip delay. The trip is reset depending on the parameterisation of the trip reset mode.

15.5 Trip Reset Mode

Function : Earth fault protection

Range : Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Earth Fault Protection / Function

Description :

An earth fault trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by parameterisation.

Remote Reset: The trip reset is only via the fieldbus.

Local Reset: The trip reset is only possible via Digital Input which is assigned for 'Reset' (or via operator panel MD.

16 PTC Protection(only for M102-P)

PTC thermistors are semiconductor elements with a very high positive temperature coefficient. PTC temperature detectors are used extensively in the protection of motors against excessive temperature rise. They are embedded directly between the phase windings on the overhang of the stator winding normally during manufacture.

In contrast to the trip class (t6) and TOL protection that responds to the load current, the PTC protection responds to the change in thermistor resistance due to temperature rise in the windings. The PTC protection is also sensitive to fall in temperature in order to make it possible to reset the trip.

The thermistors are selected to have a rated operating temperature (TNF) to correspond with the insulation class, type and construction of the motor. It's resistance increases sharply in the range of its rated operating temperature (TNF). For a temperature change of 10°C, the resistance changes ten times.

The M102-P senses this abrupt change in the resistance to execute a trip command. A trip will follow when trip level is detected by the measurement and reset is allowed when resistance is under reset level.

Parameters involved in PTC protection are as below:

Function Enable/Disable

Alarm Level

Trip Level

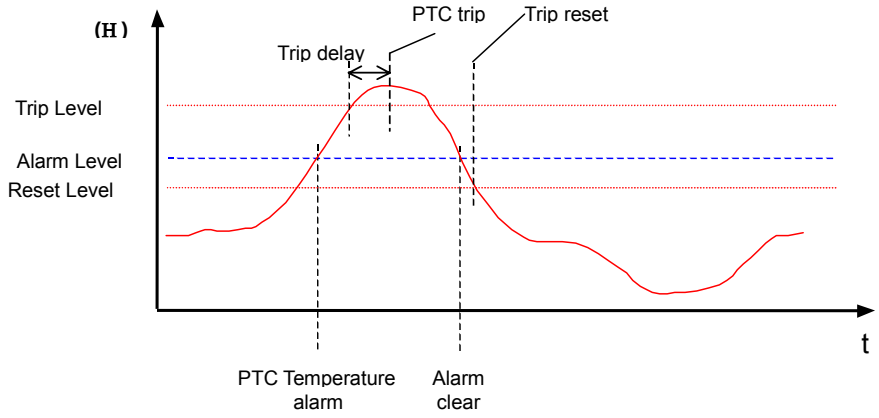
Trip Delay

Reset Level

Trip Reset Mode

Notes:

Figure 12 PTC protection.



16.1 Function Enable/Disable

Function : PTC protection

Range : Enabled / Disabled / Alarm only

Default setting : Disabled

Related parameter : PTC protection / Parameters

Description :

The PTC protection function can be disabled with the help of this parameter. When disabled, the protection function does not have any functionality in the M102-P. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

16.2 Alarm Level

Function : PTC protection

Range : 100 (1) 10,000 Ohms

Default setting : 1,600 Ohms

Related parameter : PTC protection / Function enable, disable.
Alarm mask table

Description :

This parameter defines the alarm level for the PTC protection function. The limit causes a message "PTC temperature alarm" to be issued when the measured temperature is higher than the alarm level. The temperature is measured via the PTC thermistors.

Usually, three PTC thermistors in series are built into the overhang of the stator winding at the coolant air exhaust end of the motor. The thermistors are selected to have a rated operating temperature (TNF) to correspond with the insulation class, type and construction of the motor. If the resistance corresponding to the high temperature at one or more of the thermistors exceeds this value, an ‘PTC temperature alarm’ will be generated.

The PTC temperature alarm clears automatically on reaching the normal condition, i.e. resistance restores below alarm level.

16.3 Trip Level

Function : PTC protection

Range : 100 (1) 10,000 Ohms

Default setting : 3,600

Related parameter : PTC protection / Function

Notes:

Description :

When PTC resistance remains above the 'trip level' for a pre-set trip delay time, the M102-P will generate a trip command with a message 'PTC trip'. If normal conditions are restored before the trip delay time elapses, the M102-P will go back to normal operation.

16.4 Trip Delay

Function : PTC Protection

Range : 1 (1) 1800 sec

Default setting : 1s

Related parameter : PTC Protection / Function

PTC Protection / Trip level

Description :

When the PTC resistance rises above the trip level, the M102-P will execute a trip command after elapse of the time specified in the trip delay parameter. The trip is followed with a message "PTC Trip". The count down is reset if PTC resistance goes below the trip level before the pre-set trip delay. The trip is reset depending on the parameterisation of the trip reset mode.

16.5 Reset Level

Function : PTC Protection

Range : 100 (1) 10,000 Ohms

Default setting : 1,600 Ohms

Related parameter : PTC protection / Function

Description :

Following a PTC trip, the resistance of PTC is decreasing. Until the resistance reaches the level set by this parameter, PTC trip cannot be reset. Nor can restart the motor before resetting.

16.6 Trip Reset Mode

Function : PTC protection

Range : Auto / Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : PTC protection / Function enable, disable

Description :

A PTC trip can be reset in multiple ways depending on the control philosophy. It is possible to reset the trip as desired by parameterisation.

Auto Reset: The 'PTC temperature trip' resets automatically after the sensor loop resistance goes below the threshold set for the trip-reset level.

Remote Reset: Trip reset is only possible via the fieldbus after the PTC loop resistance reaches the trip reset level.

Local Reset: Trip reset is only possible via Digital Input that is assigned for 'Reset' (or via operator panel MD).

17 Undervoltage Protection (only for M102-P)

The undervoltage protection function protects the motor against overload during voltage dips. During a mains undervoltage, the electrical energy required to drive the rotor remains same for some period owing to its inertia.

According to the energy conservation law,

Mechanical energy = Electrical energy

= VL * IL * cos ϕ …Equation 1

Where, VL is the motor line voltage, IL is the motor line current and Cosphi is the power factor.

Notes:

From equation 1, the motor draws more current during voltage dips to deliver the same mechanical energy.

The motors switched off during voltage dip or power failure can be restarted on power resumption sequentially to prevent simultaneous switch-on of the motors and thus prevent another mains failure on the network. The tripping of motors due to undervoltage of short duration can be bypassed. The feature also would help to restart the process on power resumption by sequentially starting the motors (staggered start).

The Undervoltage protection also prevents startup of the motor if the voltage is not high enough and indicates phaseloss before switching ON the motor.

Parameters involved in undervoltage protection are as below:

Function Enable, Disable

Alarm Level

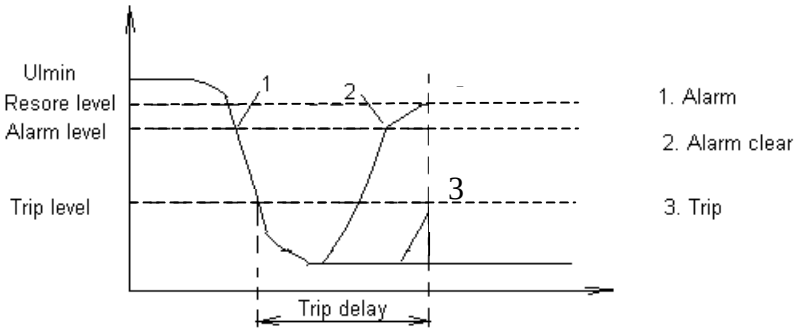
Trip Level

Trip Delay

Reset Voltage Level

Trip Reset Mode

Figure 13 Undervoltage protection.



17.1 Function Enable/Disable

Function	:	Undervoltage Protection
Range	:	Enabled / Disabled / Alarm only
Default setting	:	Disabled
Related parameter	:	Undervoltage / Parameters Autorestart / Function
Description	:	

The undervoltage protection function can be disabled with the help of this parameter. When disabled, the protection function does not have any functionality in the M102-P. Because the function of autorestart is associated with the undervoltage protection. If the undervoltage protection is disabled, the function of autorestart can not be enabled. Alarm only is an option of function disable/enable. When alarm only is active, an alarm occurs only if the measured value is more than the set alarm level.

This function is disabled automatically in the case of single-phase motor and during the motor startup period.

17.2 Alarm Level

Function	:	Undervoltage protection
Range	:	50 (1) 100%
Default setting	:	80%

Notes:

Related parameter : Undervoltage / Function

Description :

This parameter defines the voltage level for an undervoltage alarm. The undervoltage protection is based on the lowest of the measured phase voltages. An alarm 'Undervoltage alarm' is generated when the lowest of the measured voltages is below the parameterised alarm level.

17.3 Trip Level

Function : Undervoltage protection

Range : 50 (1) 100%

Default setting : 65%

Related parameter : Undervoltage Protection / Function
Undervoltage Protection / Trip delay
Autorestart / parameters

Description :

This parameter defines the trip level for the undervoltage protection function. When the lowest of the measured phase voltages goes below the trip level, the M102-P will start counting a trip delay or into autorestart procession.

17.4 Trip Delay

Function : Undervoltage Protection

Range : 0.2 (0.1) 5 sec

Default setting : 1s

Related parameter : Autorestart / Max. power down time

Description :

This parameter defines the time from the undervoltage trip level to the execution of the trip command. When the lowest of the measured phase voltages goes below the trip level for a time specified in the trip delay, the M102-P will open the contactor.

17.5 Reset Level

Function : Undervoltage Protection

Range : 50 (1) 100%

Default setting : 90%

Related parameter : Undervoltage / Trip delay
Autorestart / Max. autoreclose time
Autorestart / Max. power down time
Autorestart / Staggered start time

Description :

The reset voltage level is a voltage limit for restarting the motor after an undervoltage trip. The motor will start immediately or after a delay depending on the time during which the reset voltage level is reached (refer figure).

17.6 Trip Reset Mode

Function : Undervoltage protection

Range : Auto / Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Undervoltage / Function

Description :

An undervoltage trip can be reset in multiple ways depending on the control philosophy. It is possible to

Notes:

reset the trip as desired by parameterisation.

Auto Reset: ‘Undervoltage trip’ resets automatically after the voltage goes above the reset voltage level

Remote Reset: Trip reset is only possible via the fieldbus after the voltage goes above the reset voltage level.

Local Reset: Trip reset is only possible via Digital Input that is assigned for ‘Reset’ (or via operator panel MD).

18 Autorestart Function (only for M102-P)

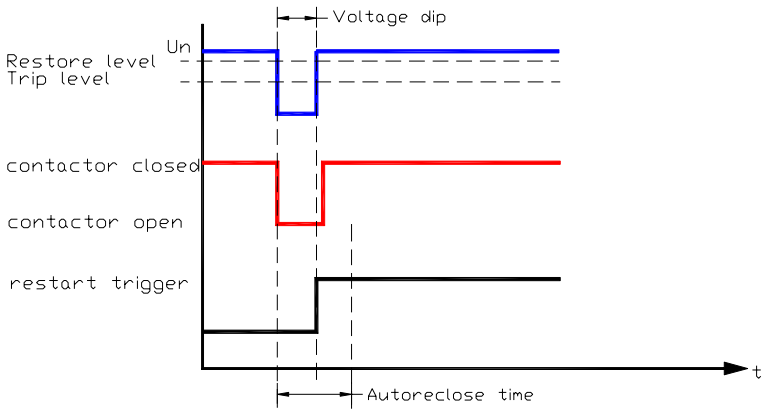
The phase A (Ua) voltage is supervised continuously. It is possible to automatically restart the motor after momentary power loss. Two alternative models of auto restart function are provided in M102-P: Standard and enhanced.

In standard mode, the reaction of the auto restart function depends on the length of the voltage dip.

The following cases show the different reactions of M102-P in different voltage dip situations.

Case 1: Voltage dip< autoreclose time

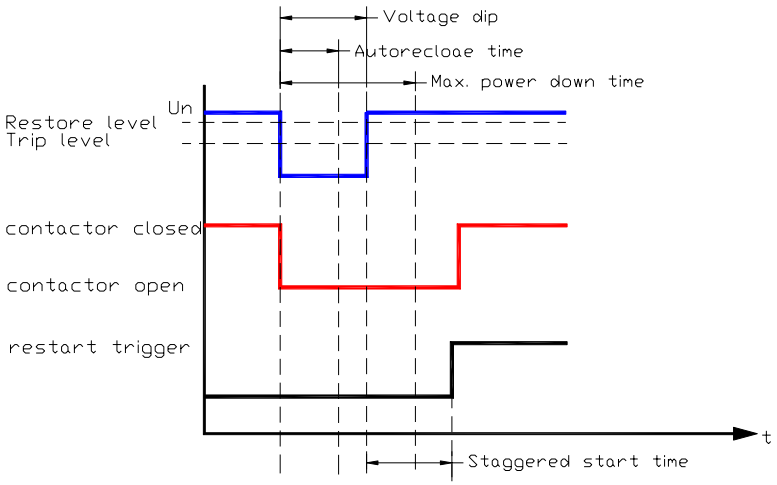
Figure 14 Voltage dip< autoreclose time



If voltage is restored within the autoreclose time, the motor will be restarted immediately.

Case 2: autoreclose time<voltage dip< Max. power down time

Figure 15 autoreclose time<voltage dip< Max. power down time

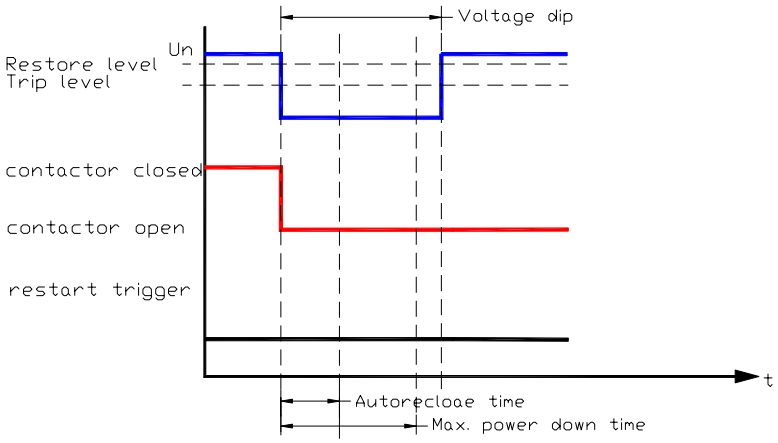


Notes:

If the supply is restored after the autoreclose time but before the Max power down time, the motor will be restarted after the Staggered start time.

Case 3: Voltage dip> Max. power down time

Figure 16 Voltage dip> Max. power down time



If the supply remain below the restore level after max power down time, no automatic restart is triggered ,even voltage restores later.

If the voltage dip is taken more serious, the enhanced autorestart function can be applied.

In the enhanced mode, the reaction of the auto restart function not only depends on the length of the voltage dip, but also the number of voltage dips within a certain time.

The following cases show the different reactions of M102-P in different voltage dip situations.

Case1: Voltage dip< autoreclose time

Identical to Standard mode Case1

Case2: autoreclose time<voltage dip< Max. power down time

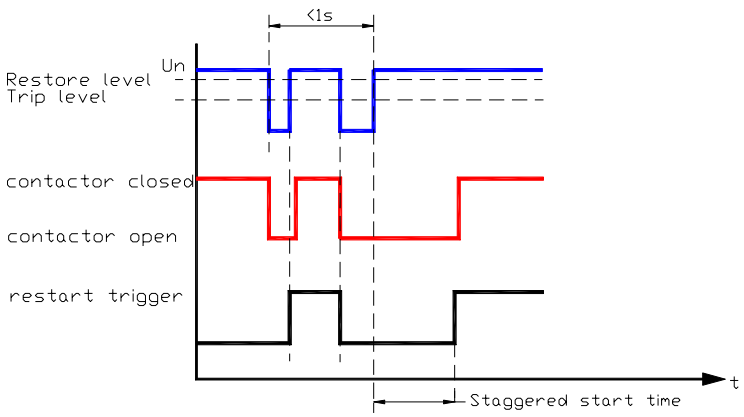
Identical to Standard mode Case2

Csae3: Voltage dip> Max. power down time

Identical to Standard mode Case3

Case4: 2xdip<200ms within 1s

Figure 17 2xdip<200ms within 1s



Notes:

If the interval between two voltage dips (which length less than 200ms) is less than 1 second. Automatic delay restart is triggered after second voltage restore.

Parameters involved in Autorestart function are as below:

Function Enable/Disable

Function mode

Max. Autoreclose Time

Max. Powerdown Time

Staggered Start Time

18.1 Function Enable/Disable

Function	:	Autorestart
Range	:	Enabled / Disabled
Default setting	:	Disabled
Related parameter	:	Autorestart / Parameters
		Undervoltage / Parameters
Description	:	

The Autorestart function can be disabled with the help of this parameter. When disabled, the autorestart does not have any functionality in the M102-P. Because the function of autorestart is associated with the undervoltage protection. If the function is to be enable, the undervoltage protection will be enable automatically.

18.2 Max. Autoreclose Time

Function	:	Autorestart
Range	:	100 (100) 1000 ms
Default setting	:	200ms
Related parameter	:	Autorestart / Function
		Undervoltage / Trip reset mode
		Undervoltage / Trip delay
		Undervoltage / Reset level
		Undervoltage / Max. power down time
Description	:	

Max. autoreclose time is the time during which the motor immediately restarts on restoration of voltage above the reset voltage level.

18.3 Maximum Power Down Time

Function	:	Autorestart
Range	:	0 (1) 1200 sec
Default setting	:	5s
Related parameter	:	Autorestart / Function
		Undervoltage / Trip reset mode
		Undervoltage / Trip delay
		Undervoltage / Reset voltage level
		Autorestart / Max. autoreclose time
		Autorestart / Staggered start time
Description	:	

The Max. powerdown time starts after the trip delay time has elapsed. It is the maximum waiting time of

Notes:

the M102-P for the power resumption. The motor would restart after staggered start delay on voltage restoration above the reset voltage level between end of max autoreclose time and max. power down time. The M102-P issues an undervoltage trip message if the voltage recover above the reset voltage level after the max. powerdown time. The trip can be reset based on the parameterisation of the trip reset mode.

18.4 Staggered Start Time

Function	:	Autorestart
Range	:	0 (1) 1200 sec
Default setting	:	5s
Related parameter	:	Autorestart / Function
		Undervoltage / Trip reset mode
		Undervoltage / Trip delay
		Undervoltage / Reset voltage level
		Autorestart / Max. autoreclose time
		Autorestart / Max. power down time
Description	:	

This parameter defines the time from the voltage rise above the reset voltage level to the time when the start command is executed. It is applicable to the motors if the voltage restores above the reset voltage level between the delay. This parameter can be used to start the motors sequentially after resumption of power to prevent voltage dip caused by simultaneous starting of several motors.

19 Start Limitation Protection

Start limitation helps to protect the motor and also the process against excess number of starts in a given interval. When the number of starts is reached and the motor is switched off, a new start is prevented. The time interval starts from the first start. After the elapse of the time interval the counter is reset to the pre-set value. The permissible motor starts per hour can be obtained from the manufacturers motor and apparatus data sheet. However, the minimum waiting time between two starts shall be complied.

The parameterisation of the protection function can be the number of starts per time interval or the time between two consecutive starts. In the first case the user must wait after the trip for the reset to take place before making a start. The time to reset after start limitation trip is provided to the fieldbus.

Independent of this function, the motor is protected by TOL function and a start is possible only if the thermal capacity is below the startup inhibit level. If motor data specifies the number of starts during a certain time span the advantage of this protection function can be taken of supervising the number of starts. On some other cases process may put requirements for the motor start number thus this protection can be employed.

Functionality is presented in the following example. The next picture, presents the start limitation protection with 3 starts allowed.

1. Normal situation, after stop command motor can be started normally, “Start 2”. Every start activates an internal timer for the time defined by time interval parameter. The number of active timers are reviewed after every stop command and compared to value of number of starts parameter. Stop command can thus exist during active or elapsed timer.

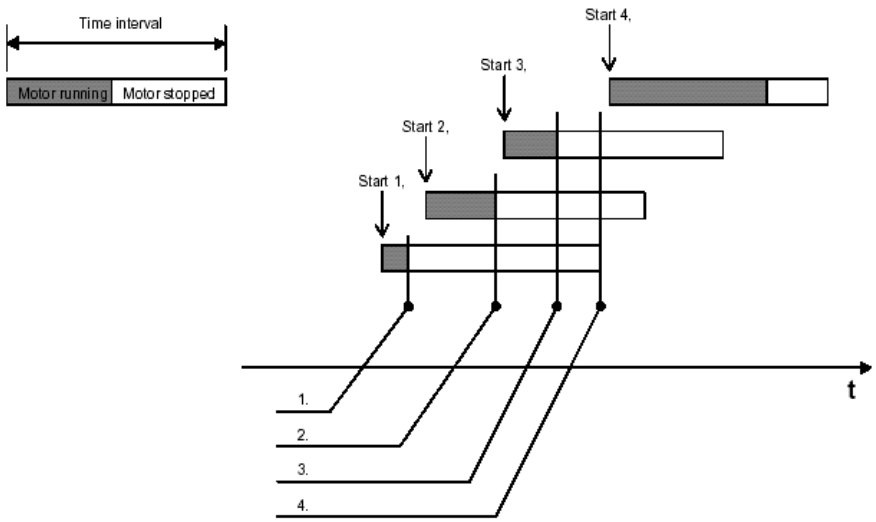
2. Two timers are still active, thus stop command generates alarm message "Start limitation alarm" and one more start is allowed, “Start 3”.

3. The 3rd start has been executed. A contactor trip and trip message "Start Limitation Trip" alarm will follow when motor is stopped while there are two active timers, here starting from “Start 1”. When start limitation trip is active the time to reset is provided to the fieldbus.

4. Trip can be reset when the first timer from “Start 1” is finished. Motor start is possible when all pending trips are reset. Supervision continues with a new timer from “Start 4”.

Notes:

Figure 18 Start limitation alarm



The parameters involved with the protection function are,

Function Enable, Disable

Time interval

Number of starts

Trip reset mode

19.1 Function Enable, Disable

Function : Start limitation protection

Range : Enabled / Disabled

Default setting : Disabled

Related parameter : Start limitation / Parameters

Description :

The start limitation protection function can be disabled with the help of this parameter. When disabled, the protection function does not have any functionality in the M101-P/M102-P.

19.2 Time Interval

Function : Start limitation protection

Range : 1 (1) 600 min

Default setting : 1min

Related parameter : Start limitation / Number of starts

Description :

During this time interval the number of starts is limited by setting the parameter number of starts.

19.3 Number of Starts

Function : Start limitation protection

Range : 1 (1) 10

Default setting : 2

Related parameter : Start limitation / Time interval

Notes:

Description :

This parameter defines the number of allowed starts during a predefined time window set by the parameter time interval. If this value is set to one, the parameterised time interval will define the time between two consecutive starts.

19.4 Trip Reset Mode

Function : Start limitation protection

Range : Remote / Local / Remote & Local

Default setting : Remote & Local

Related parameter : Start limitation / Function enable, disable.

Description :

This parameter defines the trip reset modes for the start limitation protection trip.

Remote: The 'Start limitation trip' can be reset via the fieldbus.

Local: The 'Start limitation trip' is only possible via Digital Input that is assigned for 'Reset' (or via operator panel MD).

20 Maintenance

Preventive maintenance is the best way to have long service life for any equipment. Maintenance function can be configured suitably as a reminder for preventive maintenance. This would reap high benefits to the user in terms of reduced process down time and loss due to stoppage of production.

Maintenance function indicates the operation of the motor in terms of hours run and the usage of starter in the form of operating cycles. Number of hours run helps to assess the bearing life and it's lubrication or replacement, whereas the number of operating cycles help in deciding replacement of worn-out power contacts or the contactor itself.

Maintenance alarm can be activated after lapse of the set counter. The counters can be set after maintenance according to two different principles depending of course on normal routine of the user.

Parameters under 'Maintenance function' are as below:

Running time alarm level

Start number alarm level

20.1 Running time alarm level

Function : Maintenance

Range : 0 (1) 65,535 h

Default setting : 65535(Disabled)

Related parameters : --

Description :

The user can set a period after which a preventive maintenance is desired. When the Running timer exceeds the preset running time alarm level, a message 'Maintenance hours run' is generated for the corresponding M101-P/M102-P. This helps to lubricate and maintain the bearings of the motor within the correct service interval.

When the parameter is set to 65535, the running time alarm is disabled.

20.2 Start number alarm level

Function : Maintenance

Range : 0 (1) 65,535

Default setting : 65535(Disabled)

Related parameters : --

Description :

This parameter reflects the control cycles of contactors. User can set this parameter in lines with the electrical life of a contactor. When start counter has run through the set value of cycles in preset start

Notes:

number alarm level, the corresponding M101-P/M102-P generates a message 'Maintenance contactors'. This help in carrying out preventive maintenance of power contacts.

When the parameter is set to 65535, the start number alarm is disabled.

21 DIAGNOSIS INFORMATION

M101-P/M102-P, as a slave station, gives diagnosis information to master stations on the basis of the following three groups of information.

Group 1: Alarm information for selection:

TOL, Overload, Phase Failure, Phase Unbalance, Under Load, No Load

Earth Fault, PTC, Under Voltage, Auto Reclose, Contactor Feedback,

Welded Contactor, Drive Failed to Start, Drive Failed to Stop, Start Limitation

Ready to Trip Reset, Running Time, Start Number, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12

Group 2: Trip information for selection:

TOL, Stalled Failure, Phase Failure, Phase Unbalance, Under Load, No Load

Earth Fault, PTC, Under Voltage, Contactor Feedback,

Start Limitation, Feeder, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12

Group 3: Other information for selection:

Signal (input from terminal X1): DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12

Trigger resource: Field, MD2, Field Bus, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12

Other Information: Block DP, Discrepancy in parameter settings, Hardware Fault, Parameter Status, Current of Last TOL trip

By tipping the ticket in front of each message, user can defined what message needed to send out.

22 USER DEFINED DATA

The M101-P/M102-P contains a User Definable Data area in the memory map. Three data structures are available for user to define in different applications. Up to 12 bytes data can be sent out to Profibus master station with three options of 4 bytes, 8 bytes, 12bytes.

The functions for selection are as below:

Type1: 4 Bytes In and 2 Bytes Out.

No bytes are mappable. But, in the 'Configurable Area Byte1' bit4-7 can be defined for DIs(DI0~DI12) by user.

Type2: 8 Bytes In and 2 Bytes Out.

3 bytes in are mappable by master station.

Data assignable for byte4&5 (two bytes value only) includes: Ia/In, Ib/In, Ic/In, Ua, Ub, Uc,Power Factor, Ground Current, Power, Thermistor value

Data assignable for byte6: Thermal Capacity

And 12 bits can be defined to DIs(DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12) by user.

4 bits come from 'Configurable Area Byte1' bit4-7.

8 bits come from 'User definable area byte 7'bit0-7

Note: Ua, Ub, Uc, Power Factor, Power and Thermistor value are available for M102-P' byte4 & 5.

Type3: 12 Bytes In and 2 Bytes Out

7 bytes in are mappable by master station.

Data assignable for byte4&5 (two bytes value only) includes: Ia/In, Ib/In, Ic/In, Ua, Ub, Uc,

Notes:

Power Factor, Ground Current, Power, Thermistor value

Data assignable for byte6&7 (two bytes value only) includes: Ia/In, Ib/In, Ic/In, Ua, Ub, Uc, Power Factor, Ground Current, Power, Thermistor value

Data assignable for byte8&9 (two bytes value only) includes: Ia/In, Ib/In, Ic/In, Ua, Ub, Uc, Power Factor, Ground Current, Power, Thermistor value

Data assignable for byte10: Thermal Capacity

And 12 bits can be defined to DIs(DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9, DI10, DI11, DI12) by user.

4 bits come from 'Configurable Area Byte1' bit4-7.

8 bits come from 'User definable area byte 11'bit0-7

Note: Ua, Ub, Uc, Power Factor, Power and Thermistor value are available for M102-P' byte4~byte9.

Note: 1) Only the Profibus master station can decide which of the cyclical data type (Type1, Type2 and Type3) will be mapped to the M101-P/M102-P.

2) Mcusetup_P software can be used to set the certain function for each configurable type or bit.

More details pls refer to ' Profibus DP implementation for M101/M102'.